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REPORT

OF

THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS

OF THE

CITY OF CHICAGO

APPOINTED BY
HIS HONOR, THE MAYOR, CARTER H. HARRISON
1903-1905

JOHN F. HIGGINS PRINT 279-285 MONROE STREET

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ORDINANCE.

INSTITUTING HIGH PRESSURE WATER SYSTEMS FOR FIRE PROTECTION ONLY—JULY 20, 1903.

Be it ordained by the City Council of the City of Chicago:

SECTION 1. *High Pressure Districts*—The compactly built portions of the city devoted to trade and manufactures shall be divided into districts termed High Pressure District.

SEC. 2. *High Pressure Water Systems*—In High Pressure Districts the water used for fire protection shall be delivered at high pressure by mains and pumps separate from those furnishing water for other purposes.

SEC. 3. *Commission on High Pressure Water System*—There is hereby established an Advisory Commission which shall be known as the Commission on High Pressure Water Systems and which shall act during two years and take charge of the institution of High Pressure Systems.

SEC. 4. *Commission, How Appointed*—The Commission shall comprise six representatives of business organizations and interests and seven Aldermen, who shall be appointed by the Mayor within ten days after the passage of this ordinance. The Mayor shall also appoint a hydraulic engineer. The Commission may rent rooms and hire such clerks, with the consent of the City Council, as may be required for proper dispatch of its business.

The Fire Marshal and Commissioner of Public Works shall be ex-officio members of the Commission on High Pressure Water System.

SEC. 5. *Salaries*—The members of the Commission shall serve without salary, but the Hydraulic Engineer shall be paid not to exceed $500.00 per month.

SEC. 6. *Business of the Commission, Subject to the Approval of the City Council*—The Commission shall define the limits of High Pressure Districts and determine in what order construction shall proceed; make plans and specifications of High Pressure Systems; make an examination of past fire losses to ascertain where mains are most needed; report to the City Council such modifications of the building ordinance as may be desirable in High Pressure Districts; consult with heads of departments and recommend to the City Council such provisions as may be necessary to secure proper operation of High Pressure Systems and maintenance of proper records by the city; notify property owners and tenants in proposed districts of the intent to install High Pressure Systems and solicit signatures to contracts for high pressure service.

SEC. 7. *Hydraulic Engineer*—The Hydraulic Engineer shall be experienced in High Pressure Water construction and conversant with the art of fire protection. He shall act under the direction of the Commission, prepare plans and specifications of all work and provide supervision of construction. To facilitate business routine he shall be the Hydraulic Engineer of the Commission and an assistant engineer in the office of the City Engineer.

SEC. 8. *Requirements to Be Observed*—The plans shall conform in general to the requirements established by the Advisory Board of Experts of the High Pressure Commission of 1902 and shall be submitted to the same experts or their successors for inspection and report before final submission to the Commission.

Arrangements shall be made for conducting a series of tests of appliances under the supervision of these experts. Competing manufacturers shall be charged a fee sufficient to cover the direct expense of the tests.

SEC. 9. *Districts to Be First Considered*—The Commission shall first consider plans for the district bounded by 12th street, Halsted street, Chicago avenue and the lake. General plans shall be made for this entire territory with the intent of installing systems by degrees, beginning where there is most need. Detailed working plans shall be made only for portions where immediate construction is contemplated.

The plans of the central downtown district shall conform, as far as possible, to the proposed subways and advance installation shall be confined to pumping stations, circulating mains and such branches as in the opinion of the Commission cannot be delayed, without undue loss of property by fire.

Provision for connection of fire boats shall be made and installation of fire boat mains shall be treated as advance construction of complete systems.

SEC. 10. *Other Districts*—Plans for other districts shall be considered upon petition of fifty property owners concerned and affirmative action by the City Council.

SEC. 11. *Construction of Systems*—It is hereby made the duty of the Water Department to construct High Pressure Water Systems for fire protection, and the former methods of furnishing water for fire protection are declared to be inadequate and shall be continued only in residence portions of the city and temporarily in other portions until building improvements shall become sufficiently developed to warrant installation of High Pressure Systems. The plans approved by the Commission on High Pressure

Water System, during the two years in which the Commission shall hold office, shall be constructed by the Department of Public Works, under the supervision of the Hydraulic Engineer.

SEC. 12. The Commission shall make provision for use of High Pressure Water by property owners for purpose of fire protection. The Commission shall guard the interests of the city in planning such connection and shall proceed so as to incur no liability on the part of the city by reason of such connections. The Commission shall submit for the consideration of the City Council, regulations to be observed by the property owners in making connections, penalties to be imposed for improper use of High Pressure Water and charges appropriate for different classes of property to cover cost of connection and annual service. No service shall be furnished except upon compliance with regulations established by the City Council.

SEC. 13. *Basis of Charges*—Such charges shall be based upon the value of the service to the individual in relieving him of expense to which he would otherwise be put in completing the fire protection of his property. It shall be the duty of the Commission to recommend an equitable adjustment to this business relation between the city and the individual.

SEC. 14. *Accounting*—The expenses of the Commission shall be charged to the construction account of High Pressure Systems, and exclusive of engineering work performed by the Commissioner of Public Works, shall not exceed $6,000,00 per annum.

SEC. 15. *Expenses*—The expenses of the Commission from the date of its appointment to the date of the passage of this ordinance shall not exceed the sum of one thousand ($1,000) dollars, and shall be vouchered by the Commissioner of Public Works and paid by the Comptroller from the Water Fund.

SEC. 16. This ordinance shall be in force from and after its passage.

THE COMMISSION

ON

HIGH PRESSURE WATER SYSTEMS

OF THE CITY OF CHICAGO

1903-1905

Aldermen—

HONORE PALMER, *Chairman*
JOHN J. BRADLEY
JOSEPH BADENOCH
JOHN BURNS
ERNEST BIHL
DANIEL V. HARKIN
*P. J. O'CONNELL

Business Men—

A. C. BARTLETT
GRAEME STEWART
H. G. SELFRIDGE
F. B. NOYES
C. S. PELLET
W. D. KERFOOT

EX-OFFICIO

WM. H. MUSHAM.....*Fire Marshal,* Nov., 1903, to Oct., 1904
JOHN CAMPION.....*Fire Marshal,* Oct., 1904, to April, 1905
F. W. BLOCKI.....*Commissioner of Public Works*
§GEO. W. JACKSON.....*Hydraulic Engineer*
H. B. SEELY.....*Secretary*

ORGANIZATION

EXECUTIVE COMMITTEE

Aldermen—

HONORE PALMER, *Chairman*
JOSEPH BADENOCH
DANIEL V. HARKIN

Business Men—

F. B. NOYES
W. D. KERFOOT

EX-OFFICIO

F. W. BLOCKI, *Commissioner of Public Works*
JOHN CAMPION, *Fire Marshal*
H. B. SEELY, *Secretary*

---

*Term expired April, 1904; vacancy not filled.
§Resigned Oct. 18th, 1904; vacancy not filled.

RECOMMENDATION

BY

THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS

APRIL 10TH, 1905

To the Honorable the Mayor
and City Council of the City of Chicago:

The Commission on High Pressure Water Systems respectfully recommends that provision be made for the construction of High Pressure Water Systems during the present year.

In the opinion of the Commission the provision for the central district should contemplate preparation of plans by the coming administration, which will be responsible for the construction and operation of the systems, and should therefore decide the engineering problems involved in the protection of the district. The minimum amounts which should be provided for general protection in the portions where there is most need to be expended upon the approval of such plans by the City Council, are:

South Side section	$450,000
West Side section	200,000
North Side section	175,000
Pumping Station	125,000

With reference to the proposed district at Twenty-second street and Blue Island avenue, the Commission recommends that appropriation be made for immediate construction.

Respectfully submitted,

THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS.

Aldermen—	*Business Men*—
HONORE PALMER, *Chairman*	A. C. BARTLETT
JOHN J. BRADLEY	GRAEME STEWART
JOSEPH BADENOCH	H. G. SELFRIDGE
JOHN BURNS	F. B. NOYES
ERNEST BIHL	C. S. PELLET
DANIEL V. HARKIN	W. D. KERFOOT

EX-OFFICIO

Fire Marshal—	*Com. of Public Works*—
JOHN CAMPION	F. W. BLOCKI

H. B. SEELY, *Secretary.*

REPORT

TO THE

COMMISSION ON HIGH PRESSURE WATER SYSTEMS

BY

THE CHAIRMAN, ALD. HONORE PALMER

To the Honorable, the Commission on High Pressure Water Systems:

GENTLEMEN—I submit herewith the report directed by the Commission in the resolution passed February 1st, 1905. The several detailed reports and data called for by the resolution appear in their appropriate order.

Attention is called to the contrast between the interest in the High Pressure proposition at the outset of the movement in this city three years ago and the widespread interest throughout the country today. At that time Philadelphia and Chicago alone were engaged in taking preliminary steps; today, the system in Philadelphia is in operation, Manhattan and Brooklyn are laying pipes, Toronto and Winnipeg are letting contracts, and Cleveland and Baltimore are ready to act.

The occasion of such great interest is the remarkable series of notable fires which devastated large areas in several cities during the year 1904.

That the delay in installing the system in Chicago is extremely hazardous is demonstrated both by these fires and the effect in hastening action in so many cities; all cannot be wrong. In none of these cities is there hesitation to accord first place to the need for safety in the business center. That the interest in this area is the direct interest of every citizen who works or provides work is unquestioned. The facts presented in the several reports should be examined carefully. The proof is convincing that further inaction is a policy no citizen can afford to accept.

Respectfully submitted,

Honore Palmer.

REPORT

TO THE

COMMISSION ON
HIGH PRESSURE WATER SYSTEMS

BY

THE SECRETARY, HERMAN B. SEELY,
Consulting Fire Protection Engineer

To the Honorable, the Commission on High Pressure Water Systems:

GENTLEMEN—In preparing my report I have endeavored to answer concisely the several questions which are called forth by the consideration of a High Pressure System for fire service.

Thanks are hereby tendered and acknowledgement made to the Municipal Authorities of Providence, Philadelphia, New York, Cleveland, Baltimore, Buffalo, Toronto and Winnipeg for the very valuable information which they have contributed thus enabling the answers to the several questions to be made with certainty; also to the Universal Adding Machine Company for the loan of an adding machine which facilitated the tabulation of the thousands of items pertaining to fire losses, fire alarms and buildings in the Central High Pressure District; to the Samuel Eastman Company, for the loan of plates showing fire streams; to H. H. Glidden, Manager Chicago Fire Underwriters Association, for the compilation of the total fire losses and premiums in Chicago since the great fire; to John Ericson, City Engineer, and John Campion, Fire Marshal, for data furnished in connection with cost of construction of the High Pressure System and cost of operation of the Fire Department in the Central High Pressure District.

QUESTION 1. WHAT WILL THE HIGH PRESSURE SYSTEM IN THE CENTRAL DISTRICT COST?

The Central District is bounded by 12th Street, Halsted Street, Chicago Avenue and the Lake, and is subdivided by the Chicago River into South, West and North Sections.

Two Types of Systems—The cost of a high pressure system is materially affected by certain leading features of the design. The aim may be certainty and ease of delivery through duplicate pumping stations and feed mains surrounding a gridiron of large pipes with allowance of but fifty pounds loss of pressure or the loss of pressure may be 100 pounds, the pipes of the gridiron small and the single feed main centrally located with but one pumping station at one end. The joints may be calked or the ends of the pipes may be flanged and bolted together. Two divergent types of high pressure systems arise from the choice made in these particulars and the plans proposed for Chicago illustrate each phase of the several questions.

The plan prepared in accordance with the requirements of the Advisory Board of Experts of 1902, Plate D, Page 56, contemplates 50 pounds loss of pressure under delivery of 30,000 gallons per minute and three pumping stations with numerous feed mains surrounding gridirons of large pipes. The plan described in the report of the Hydraulic Engineer, Mr. Geo. W. Jackson, Plate 1, Page 66, contemplates 100 pounds loss of pressure under delivery of 30,000 gallons per minute and one large pumping station with one central feed main supplying gridirons of small pipes.

The estimated cost of the system delivering 30,000 gallons per minute with 50 pounds loss of pressure is.....$1,645,000
The estimated cost of the system with 100 pounds loss of pressure is..... 2,883,000

The wide variance in cost is due to the selection of existing pumping stations as the sites of the high pressure pumps in the one case while in the other the estimate includes an allowance for ground and the erection of an independent pumping station; also, the maximum pressure contemplated in the lower cost system is 200 pounds, while that of the higher cost system is 300 pounds.

Further illustration of the two typical arrangements is presented by the plan adopted in New York and the plan executed in Philadelphia. The plan adopted in New York follows the scheme of duplicate parts with moderate loss of pressure while that of Philadelphia involves 100 pounds loss of pressure with one pumping station and central feed main. Full particulars of the foregoing systems and estimates of the cost may be found as follows:

Page.
Chicago, 50 pounds loss of pressure.....56
Chicago, 100 pounds loss of pressure 65
Philadelphia, 100 pounds loss of pressure 86
New York, 50 pounds loss of pressure 91

TABLE I.

Tabulation was made of the details of cost in the cities quoted but in the case of New York only the general features of the system for the Borough of Manhattan were obtainable, and in the remaining items the details given in the proposals for the similar system in the Borough of Brooklyn were used in their stead.

TABLE 1

POINTS OF VARIANCE IN TYPICAL SYSTEMS.

	Loss of Pressure. Pounds.	Capacity, Gallons per Minute.	Pumping Stations.	Style of Joints.	Length of Mains. Feet.	Average Diameter of Mains. Inches.	Cost of Mains	Total Cost
Chicago, South Section	50	10.000	1	Calked joints.	108,400	13 7	$ 800 000	$ 910 000
Central District	50	30.000	3	Calked joints.	235,700	13.75	1 315 000	1 645 000
Borough of Manhattan	50	30.000	2	Calked joints.	.....	.....	.....	3 950 400
Borough of Brooklyn	.....	.....	.....	.....	123,900	14.7	872 000	.....
Chicago, South Section	100	10 000	1	Bolted joints..	141 600	10	1 259 540	1 750 540
Central District	100	30,000	1	Bolted joints.	268,900	9 6	1 985 000	2 883 000
Philadelphia	100	9,100	1	Bolted joints..	33,442	8.8	463 260	641 260

Maximum Pressure—The question of maximum pressure is one of practicability as well as cost. While most cities have adopted the limit of 300 pounds, none explains how the difficulties experienced with this pressure in Philadelphia are to be met. Philadelphia provided for 300 pounds pressure, but has found no occasion to exceed 200 pounds in service at fires; during tests however, attempts were made to exceed 200 pounds, which resulted in serious injury to the firemen holding the nozzle. (Page 88.) On the other hand, a maximum pressure of 200 pounds, not only avoids all questions of practicability but admits of a lighter standard of strength both in the entire piping system itself and in all apparatus to be connected with the system by property owners or the fire department.

In view of these important considerations a careful canvas was made of all points in the situation to determine whether 200 pounds pressure would suffice for all possible demands. It appears from an analysis that the combination of the High Pressure System and connecting stand pipes can be so arranged that 200 pounds pressure will unquestionably meet every possible contingency of demand. (Page 60.)

The system shown in Plate D, Page 56, will deliver the following volumes of water at the tops of stand pipes with the pressures noted, which have the same meaning at these levels as those usually quoted for hydrants at the level of the street.

TABLE II.

Delivering 21,000 gallons per minute, 160 feet level, 98 to 103 pounds pressure.

Delivering 21,000 gallons per minute, 210 feet level, 74 to 82 pounds pressure.

Delivering 21,000 gallons per minute, 260 feet level, 60 to 62 pounds pressure.

Delivering 30,000 gallons per minute, 160 feet level, 73 to 78 pounds pressure.

Delivering 30,000 gallons per minute, 210 feet level, 44 to 56 pounds pressure.

Delivering 30,000 gallons per minute, 260 feet level, 35 to 37 pounds pressure.

The pressures obtainable at the levels noted would enable 30,000 gallons per minute to be directed effectively against

heights of 275 feet and 21,000 gallons per minute against heights of 325 feet. The conditions pertaining to the height of buildings in Chicago justify the conclusion that demands more severe than these cannot arise. The limit of height permitted by ordinance is 260 feet: Few now avail themselves of the full limit and none has asked permission to exceed the limit. The concensus of interest in the future will tend toward the enforcement of the restriction rather than toward evasion. The question of height of buildings is discussed fully on page 59, and tables are given showing the number of buildings of various heights.

The pressures yielded by the High Pressure System at various high levels may seem small to those unacquainted with the nature of the fire streams which issue from large pipes backed by ample capacity and delivering great volumes of water without serious loss of pressure. Plates A, B, and C are photographs of such streams produced from street hydrants under pressures similar to those quoted for the tops of stand pipes connected with the High Pressure System, assuming volumes of 21,000 and 30,000 gallons per minute.

PLATE A - - - - - - CONCORD, N. H.
Size Nozzle - - - - - - 2¾ Inch
Distance Thrown - - 278 Feet
Pressure at Hydrant, 81 Pounds

PLATE B - - - - - - BOSTON, MASS.
Size Nozzle - - - - - - 3 Inch
Distance Thrown - - 340 Feet
Hydrant Pressure, 82 Pounds

PLATE C - - - - SOMERSWORTH, N. H.
Size Nozzle - - - - 2 Inch
Distance Thrown - - 196½ Feet
Hydrant Pressure, 65 Pounds

No fires can resist the streams shown in Plates A, B, and C when attacked promptly from levels which admit of nearly horizontal delivery so that the streams penetrate to the seat of the fire in the burning structure. On the other hand there is no assurance that any number of streams of any manageable power directed from the level of the street will avail in a sweeping high level fire; the seat of the fire is not touched. The ability to stop the high level fire which is about to spread is evidently the ability to prevent the high level conflagration. Only high level powerful streams directed close to the horizontal can confer the ability and no medium can serve to this end so well as a system of stand pipes in connection with the High Pressure System. The stand pipes in the buildings are of equal importance with the hydrants in the streets and the planning of the stand pipes is an essential part of the design of a complete high pressure system.

Methods of Financing High Pressure Systems—The cities which have become interested in the high pressure system consider the improvement to be general in its nature, requiring isue of bonds. The City of Winnipeg is an exception in proposing to build the system by special assessment, the city in general assuming the burden of operation and maintenance.

The ordinance which was adopted July 20th, 1903, in Chicago provides for the construction of High Pressure Water Systems by appropriation from the Water Fund, and the Corporation Counsel, Mr. Edgar B. Tolman, has rendered an opinion to the Commission on High Pressure Water Systems (Page 51), that such procedure is unquestionably legal.

Connection with Buildings—Owing to the greater thought given to the possibilities of the High Pressure System as an active rather than reserve factor in fire protection, and also to the desire for revenue to apply towards operation and maintenance, the stand in behalf of connecting apparatus of buildings with the High Pressure System is more advanced in Chicago than in the other cities. The view point in other cities is different, yet nearly all are considering some form of connection favorably, and in Providence where the system is of comparatively long standing, five connections with installations of automatic sprinklers have recently been made. An annual charge of $50.00 is imposed for each connection.

Telephone System—The operation of the High Pressure System requires telephones accessible to the fire depart-

ment during fires. Under the charters granted to the telephone companies the city is entitled to telephones for this purpose at a rental of $5.00 per annum each.

If the city decided to exercise this option the item would become one of operation, and it has therefore been omitted from consideration in connection with the cost of construction.

Comparison of Views—Table III shows the atitude of the several cities upon the leading questions arising from the consideration of a high pressure system and also the obtainable details of arrangement and cost.

The correspondence connected with each city is printed in pages 84 to 95, inclusive.

QUESTION II. WHAT WILL THE OPERATION OF THE HIGH PRESSURE SYSTEM COST?

The discussion of the cost of direct operation should follow the consideration of the effect of the High Pressure System upon the entire burden of expense imposed by fire. If the fires decrease in extent, the demand upon the fire department will be lessened, so that the cost of direct operation will not only be small but many times offset by the saving in existing expenses.

The Large Fire—The large fire is the sources of the bulk of the annual loss, the occasion of the heavy work of the fire department and the progenitor of the conflagration. If the handling of the High Pressure System can be so directed that the large fire becomes rare, its products must also become inconsiderable.

From the nature of things the conflagration become impossible as the large fire become improbable.

The conclusion of an extensive inquiry demonstrates the importance of the large fire to be correctly stated and that the buildings which generate these fires can be treated in connection with the High Pressure System so that the large fires become rare with consequent increase in safety and decrease in waste.

In order to demonstrate the conclusion it is necessary to know the kind of buildings which develop large fires and the size above which fires as a rule are large and below which fires are small; also that the buildings producing large fires and those producing sweeping fires are identical in size and character. The large fire is evidently one, the control of which requires a large force. The buildings which cause large fires may, therefore, be detected by tracing the sources of the calls for a large force and

klers.

the study of the facts pertaining to these buildings will enable answers to all phases of the problem.

Collection of Data.—The following facts were gathered analyzed, classified, and tabulated in pursuance of the inquiry.

Facts pertaining to the most notable sweeping fires of 1904 in other cities.

Facts pertaining to fire alarms and fire losses during the five years from 1900 to 1904, inclusive, in the Central High Pressure District, bounded by Twelfth street, Halsted street, Chicago avenue, and the lake. A census was taken of all buildings in the district larger than 10,000 square feet floor area except public buildings, railroad freight houses, train sheds, elevators, stores and flats and dwellings. The term floor area means the ground area multiplied by the number of floors and basement.

The Analysis of Data.—The analysis sought to determine: First, what portion of the loss and heavy work of the fire department was chargeable to large fires: second, what kind of buildings were most influential in causing loss and heavy work by the fire department; third, what sizes of floor areas were most influential in these particulars; fourth, what kind and size of buildings started the most notable recent sweeping fires in other cities; and fifth, what expedients should be used in connection with the High Pressure System to make the large fire rare.

The several tabulations exhibit situations as follows:

TABLE IV.

Grand totals. (Areas over 10,000 square feet.)
Number of buildings, 2,247.
Total floor area, 98,308,107 square feet.
Number of fires, 773.
Total loss, $9,260,889.37.

FIRST STEP IN THE ANALYSIS.

TABLE V.

Relation of special call fires to grand totals.

Total number of fires	774
First alarms	612
Special alarms	162

Ratio of special calls to the total number, 21 per cent.

First alarm fires	1,446,964 90
Special alarm fires	7,813,943 38

Ratio of special call loss to total loss, 84 1-3 per cent.

Many special calls are precautionary only and the additional engines are idle. These may be eliminated by considering only those fires of $50,000 loss and over.

TABLE VI.

Special calls and fires of $50,000 loss and over.

Total number of fires.....48
First alarm calls..... 1
Special alarm calls.....47

Ratios of $50,000 fire special calls to the total number of $50,000 and over fire calls, 98 per cent.

Ratio of $50,000 fire special calls to the total number of all special calls, 29 per cent.

Ratio of $50,000 fire special calls to total number of all calls, 6 per cent.

TABLE VII.

Total loss in $50,000 and over fires.....$5,866,417.35
First alarm losses..... 73,113 60
Special alarm losses 5,793,303.75

Ratio of $50,000 fire special call loss to total of $50,000 and over fire losses,98.75 per cent.

Ratio of $50,000 fire special call loss to total of all special call losses, 75 per cent.

Ratio of $50,000 fire special call loss to total of all losses, 63 per cent.

The special calls include all the heavy work of the fire department, and 84 per cent of the total loss by fire. The fires as large as $50,000 and over represent all the heavy work of the fire department, and the special call fires of this size equal 98 per cent of the number of such large fires, 74 per cent of the special call fire loss and 63 per cent of all loss.

Deduction.—The large fire is the source of the bulk of the fire loss and the occasion of the heavy work of the fire department.

SECOND STEP IN THE ANALYSIS.

TABLE VIII.

Kind of building most influential in losses.

	No.	*Total Floor Area.*	*Total Loss.*
Ordinary and mill bldgs.	1,788.	56,767,764 sq. ft.	$8,983,749 05
Fire proof bldgs.....	157.	20,679,142 sq. ft.	187,766 72
Sprinklered bldgs., (F. P., mill and ord.).....	302.	20,861,201 sq. ft.	89,373 60

TABLE IX.

Kind of building most influential in special calls and special call losses.

	No. of Bldgs.	Total Floor area, sq. ft.	No. of Fires.	Total Loss.
Ordinary and mill bldgs.	1788	56,767,764	158	$7,680,684.67
Fire proof buildings	157	20,679,142	3	124,504.32
Sprinklered buildings (F. P., mill and ord.)	302	20,861,201	1	8,754.39

TABLE X.

Kind of building most influential in special call losses of $50,000 and over.

	Number.	Total Floor Area, sq. ft.	No. of Fires.	Total Loss.
Ordinary and Mill Bldgs.	1,788	56,767,764	47	$5,729,013.67
Fireproof Buildings	157	20,679,142	1	64,290.08
Sprinklered Buildings. (F. P., Mill and Ord.)	302	20,861,201	..	No Loss.

The ordinary and mill buildings constitute only 58 per cent of the total area but produce 97 per cent of the total loss, 98 per cent of the special call loss, 98 per cent of the number of fires of $50,000 and over, and 99 per cent of the total loss in such fires.

Deduction.—The bulk of the loss and almost the entire activity of the fire department is occasioned by ordinary and mill buildings not protected by Automatic Sprinklers.

THIRD STEP IN THE ANALYSIS.

TABLE XI.

Sizes of floor areas, ordinary and mill buildings most influential in Losses.

Floor Areas.	Number.	Average.	Total Area.	No of Fires.	Total Loss.
Less than 35,000 ft.	1,245	20,472 ft.	25,488,248 ft.	437	$2,459,486.76
More than 35,000 ft.	543	57,605 ft.	31,279,517 ft.	249	6,524,262.29

Ratio of loss in areas less than 35,000 ft. to total ordinary building loss, 27½ per cent.

Ratio of loss in areas more than 35,000 ft. to total ordinary building loss, 72½ per cent.

TABLE XII.

Sizes of floor area, ordinary and mill buildings most influential in special calls:

Floor Areas.	Number of Bldgs.	Average area.	Total area.	No. of Fires.	Total Loss.
Less than 35,000 ft.	1,245	20,472 ft.	25,488,247 ft.	71	$1,551,389.80
More than 35,000 ft.	543	57,605 ft.	31,279,517 ft.	87	6,129,294.87

Ratio of special calls in ordinary buildings of less than 35,000 feet areas, to total number of special calls in ordinary buildings, 45 per cent.

Ratio of special calls in ordinary building of more than 35,000 feet areas, to the total number of special calls in ordinary buildings, 55 per cent.

Ratio of special call loss in ordinary buildings of less than 35,000 feet area to the total special call loss in ordinary buildings, 20 per cent.

Ratio of special call loss in ordinary buildings of more than 35,000 feet area to the total special call loss in ordinary buildings, 80 per cent.

TABLE XIII.

Sizes of floor areas, ordinary and mill buildings, most influential in special call $50,000 and over fire loss:

Floor Areas.	No. Bldgs.	Average Area.	Total Area.	No. Fires	Total Loss.
Less than 35,000 ft.	1,245	20,072	25,488,247	10	$ 807,943.99
More than 35,000 ft.	543	56,605	31,279,517	36	4,921,069.68

Ratio of $50,000 or over special calls in ordinary buildings of less than 35,000 feet area to the total number of $50,000 and over special calls in ordinary buildings, 22 per cent.

Ratio of $50,000 or over special calls in ordinary buildings of more than 35,000 feet area to the total number of $50,000 and over special calls in ordinary buildings, 78 per cent.

Ratio of $50,000 or over special call loss in ordinary buildings of less than 35,000 feet area to the total of $50,000 and over special call loss in ordinary buildings, 14 per cent.

Ratio of $50,000 or over special call loss in ordinary buildings of less than 35,000 feet area to the total of $50,000 and over special call loss in ordinary buildings, 86 per cent.

The rate of annual loss per 1,000 square feet in ordinary and mill buildings of less than 35,000 feet area is $19.30.

The rate of annual loss per 1,000 square feet in ordinary and mill buildings of more than 35,000 feet area is $41.71.

The ordinary and mill buildings of 35,000 square feet and over floor area constitute only 55 per cent of the total of ordinary and mill building areas, but produce 72 per cent of the total loss in such buildings, 78 per cent of the number of fires of $50,000 and over in such buildings, and 86 per cent of the total of such loss. The rate of annual loss per thousand square feet in areas more than 35,000 square feet is more than double the rate in areas less than 35,000 square feet.

Deduction.—The bulk of the loss and almost all the special work of the fire department arises from ordinary and mill buildings of more than 35,000 square feet floor area not protected by automatic sprinklers.

It was ascertained by trial that 35,000 square feet was the dividing line in areas at which a marked increase in loss per 1,000 square feet per annum was observable as compared with combinations of areas less than 35,000 square feet. Fires become less controllable at this point.

FOURTH STEP IN ANALYSIS.

TABLE XIV.

Kind and size of buildings which started the most notable sweeping fires of 1904:

Fires.	*Baltimore.*	*Toronto.*	*Rochester.*
Number of Floors	6B	3 to 4B	1 to 6
Total Floor Area	91,000 sq. ft.	40,000 sq. ft.	40,000 sq. ft.
Construction	Ordinary	Ordinary	Ordinary
	Wholesale	Neckwear	Retail
Use	Dry goods	Manufacturer	Dry goods
Watchman in Premises	None	None	Yes
Watchman in Street	None	Yes	None
Automatic Fire Alarm	Yes	None	None
Automatic Sprinklers	None	None	None
Fireproof Bldgs. Destr'y'd.	Several	None	Several
Sprinkler Bldgs. Damaged or Destroyed	Several	Several	None
Bldgs. of Moderate Floor Area Damaged or Destroyed	Many	Many	Several

NOTE.—Areas of buildings in Toronto and Rochester are taken from the map and adjoining buildings with connecting opening shown on map taken as one building.

Deductions.—The sweeping fires were started by buildings identical in size and character with those found to be producing large fires in Chicago with frequency and regularity.

The buildings damaged or destroyed consisted in part of better buildings and small ordinary buildings which are identical in size and character with those found in Chicago to be almost exempt from large fires.

No business district, therefore, can be safe so long as buildings remain which produce large fires with frequency and regularity. Under such conditions the conflagration must eventually emerge to which the better buildings can oppose no effectual barrier.

The business district which is not generally safe is unsafe.

FIFTH STEP IN THE ANALYSIS.

RELATIVE PROPORTION OF SAFE AND UNSAFE AREAS.

Thus far the analysis has detected three groups of property which would not imperil general safety in connection with the increased celerity and power of the High Presure System, namely: Fire Proof Buildings, Sprinklered Buildings and Ordinary and Mill Builings of less than 35,000 square feet floor area.

On the other hand one group of ordinary and mill buildings remains which endangers what otherwise would be a condition of general safety.

TABLE XV.

Totals of kinds of floor areas over 10,000 square feet and fire losses.

	Number.	Total Area, Square Ft.	Loss.
Ordinary and mill buildings less than 35,000 square feet	1,245	25,488,247	$2,459,486.76
Fireproof buildings	157	20,679,142	187,766.72
Sprinklered buildings	302	20,861,201	89,373.60
Total Safe Areas	1,704	67,028,590	$2,737,127.08
Unsafe ordinary and mill bldgs. over 35,000 sq. ft	543	31,279,517	$6,524,262.22

Ratio of the unsafe buildings to the total numeber of buildings, 24 per cent.

Ratio of the total area of unsafe buildings to the total area of all buildings, 32 per cent.

Ratio of the total loss in unsafe areas to the grand total loss, 70 per cent.

Should Unsafe Buildings Be Tolerated—The few buildings thus segregated as unsafe are old buildings which could not be erected under the existing ordinance. In the opinion of the City Council, the erection of such buildings would be contrary to the general welfare, but the injury to the common good is not avoided in the presence of such buildings because the erection antedated the rendering of the opinion. Moreover the facts are with the City Council.

The question arises therefore should these buildings be made safe or should they be tolerated in the hope that the fierce fires which they produce will be controlled beyond controversy by the High Pressure System. Unquestionably such toleration is not only fool hardy, but without support from business motives.

So long as there is argument there will be high rates of fire insurance; so long as fierce fires persist there will be constant heavy duty for the fire department and funds must be diverted from the protection of districts which lack ordinary provision but which rarely occasion heavy duty.

What Can Be Done in Old Buildings to Make Them Safe—In considering what should be done to make old buildings of large floor area safe, the decisions should be governed by three principles.

1. *The efficiency of the expedients must be demonstrated by experience.*

2. *The application of the expedients must be feasible without ruinous alterations.*. The interest upon the cost of such alterations may easily be many time the charge for conflagration insurance.

3. *Feasible expedients must also make the large fire rare.* The feasible expedient which makes the large fire rare will not only make the conflagration a negligible quantity but also remove the cause of the bulk of the loss and the occasion of the heavy work of the fire department. *It will pay.*

Table XVI. has been compiled to show what expedients can qualify under the test thus proposed.

TABLE XVI.

COMPARISON OF EFFECTS, CENTRAL HIGH PRESSURE DISTRICT. AREAS OVER 10,000 SQUARE FEET

	Number.	Total Floor Area.	Average Floor Area	Total Loss.	Annual Loss per 1,000 Feet Floor Area.
Business Buildings—					
Ordinary and mill, 35,000 square feet and over	444	24 948 565	56,190	$ 6,256,234 82	$ 46 34
Ordinary and mill, sprinklered buildings	277	16,797,738	50.641	89,373 60	1 23
Fire-proof buildings	64	6,169 378	96.396	61,042 48	2 22
Fire-proof sprinklered buildings	25	4.063.463	162.538	No loss	No loss
Ordinary and mill buildings, less than 35,000 square feet	1,050	21 602 651	20,574	2,386,949 44	21 61
Office Buildings, Clubs, Hotels and Lodging Houses—					
Ordinary and mill buildings, 35,000 square feet and over	92	6,105.538	65.712	132,187 59	3 50
Fire-proof buildings	86	13,657.714	158 809	62,434 16	1 12
Ordinary and mill buildings, under 35,000 square feet	195	3,881,571	19,905	72.537 32	2 90

NOTE—In calculating rates of annual loss per 1,000 square feet of area the respective areas were corrected to represent averages of periods.

Business Buildings—The restriction of floor area in ordinary and mill buildings to less than 35,000 square feet reduces the rate of loss in larger areas 54 per cent. The use of fireproof construction, 95 per cent. The use of automatic sprinklers, 97 per cent. The use of automatic sprinklers and fireproof construction, 100 per cent.

Office Buildings, Clubs, Hotels and Lodging Houses—The restriction of floor area in ordinary construction buildings to less than 35,000 square feet reduces the rate of loss in larger areas 20 per cent. The use of fire-proof construction, 68 per cent.

Deduction.—The restriction of the total floor area in ordinary and mill buildings to less than 35,000 square feet, fire proof construction and automatic sprinklers each make the large fire rare.

The automatic sprinkler can be applied to old buildings without ruinous alterations.

It is feasible, therefore, to impose a condition of general safety upon the Central District. The provisions of the building ordinance require stand pipes and hose for the protection of all buildings over 100 feet high, affecting a large number of existing fireproof, ordinary and mill buildings. The application of the principle thus recognized by the ordinance would be sufficiently general if non-hazardous buildings over 35,000 square feet area received similar treatment and ordinary and mill business buildings of 35,000 square feet floor area and over were protected by automatic sprinklers.

Fire Calls and Loss as Now and as with Standard District.—The total fire calls and loss which would emanate during five years from the High Pressure District thus made standard can be estimated accurately from what is known about the district in these respects as it exists today.

The class of buildings which may set all estimates at naught by a concourse of exceptional fires is not represented in the standard district. The large classes in which the exceptional fires are so rare as to scarcely affect short term averages are the only ones with which the estimate deals. Some deduction should also be made from the rates assigned to these classes to allow for the superior facilities of the High Pressure System.

Rapid fire and power should count in fire fighting as in sea fighting.

Philadelphia reports after one years trial of the High Pressure System that "fire losses according to the Board of Underwriters have been reduced."

The Fire Chief of Providence says after handling the system eight years, "that six streams from any hydrant can be brought into service before one engine can be placed in line," also, "without this service the fire losses would unquestionably have been much greater."

Ten per cent therefore is certainly a conservative appraisal of the improvement which may be expected from the system proposed for Chicago which would not stop at the street level but would extend to every spot where fire might lurk.

Table XVII exhibits the various totals of the two districts in parallel columns.

The increase and decrease in the areas of the standard district as compared with the present district represent changes due to estimated growth and the transfer of the present unsafe areas to the sprinklered class. The unsafe areas are identical in construction and area with the class of buildings now protected by automatic sprinklers, consequently no more should be added to the loss now experienced by the sprinklered class than would be proportionate to the additional area less the credit for high pressure protection. The areas in the former tabulations show the standing at the beginning of 1905, and in forming the rates of loss, appropriate allowances were made to establish the averages for the five years. The areas assumed for the standard district are the future averages to which the rates were applied in establishing the estimated losses.

TABLE XVII.

FIRE CALLS AND LOSSES COMPARED.

CLASS OF BUILDINGS.	PRESENT DISTRICT, ACTUAL.					STANDARD DISTRICT, ESTIMATED.			
	Av. Floor Area in Service.	Special Alarms.	First Alarms.	Total Loss.	Annual Loss per 1,000 Sq. Ft.	Average Floor Area in Service.	Special Alarms.	First Alarms.	Total Loss.
Fire-proof sprinklered business	2,600,000	None	None	None	.....	5,000,000	None	.....	None
Ordinary sprinklered business	14,400,000	1	48	$ 89,373 60	$ 1 23	50,000,000	None	170	$ 267,750
Fire-proof business	5,500,000	1	12	61,042 48	2 22	8,000,000	None	19	79,920
Fire-proof office	11,000,000	1	24	62,434 16	1 12	18 000,000	None	41	90,780
Ordinary office, less than 35,000 feet	5,000,000	2	79	72,537 32	2 90	5 000,000	None	81	65,250
Ordinary office, more than 35,000 feet	7,500,000	4	36	132,187 59	3 50	7,000,000	None	37	105,750
Ordinary business, less than 35,000 feet	22,000,000	66	290	2,386,949 44	21 61	* 15,000,000	None	243	1,458,675
Ordinary business, more than 35,000 feet	27,000,000	83	223	6,256,234 82	46 34	† None	None	.....	None
Theatres	.....	4	.....	200,130 06	.....	Theatres	None	4	150,000
Miscellaneous, and less than 10,000 feet	.....	7	543	269,519 65	.....	Miscellaneous	None	605	270,000
	.....	169	1,255	$ 9,530,409 12	.....	.....	.....	1,200	$ 2,488,125

* Five million changed to sprinklered. † All changed to sprinklered.

The total values at risk in the two tabulations are probably, as now	$ 300,000,000 00
As with Standard High Pressure	335,000,000 00
The annual loss is now	2,000,000 00
As with Standard High Pressure	500,000 00
The rate of loss on the $100.00 as now	66
As with Standard High Pressure	14
The reduction of loss in the central district is	75 per cent
The reduction of loss in the entire city	30 per cent
The reduction in first alarms, central district, is	4 per cent
The reduction in special alarms, " "	100 per cent

The Direct Cost of Operation—If independent stations are planned, the annual cost of operating one station of 30,000 gallons per minute capacity in constant readiness to meet the conflagration would be about $35,000. Of three independent stations, same total capacity, $50,000 to $60,000.

If on the other hand, the existing pumping stations are selected as sites for the high pressure pumps so as to use the existing force in part and steam as power, the allowance for the entire cost of maintenance and operation of the system should not exceed $25,000 per annum. This assumes that the fire department will take care of valves and also open and shut valves at fires. (Page 61.)

QUESTION III. WILL THE COST OF OPERATING THE FIRE DEPARTMENT BE LESS IN CONNECTION WITH THE HIGH PRESSURE SYSTEM?

Uuquestionably, yes. Not one fire engine or fire boat will be used throughout the district protected by the system and the entire capacity of the system can be thrown upon one fire with a moderate force of men.

The greater the fire the greater the *number* of streams was the old rule, the greater the fire the greater the *size* of the streams is the modern rule.

The modern appliance permits the size of the streams to be increased proportionately with the fire without increasing the force handling the streams.

More, therefore, can now be accomplished by a light force handling heavy streams than has hitherto failed of accomplishment with a heavy force handling light streams.

The displacement of the fire engine service by the high pressure service is an accomplished fact.

The capacity of the Providence System is only 3,500 gallons per minute which necessitates the presence of steam fire engines at all fires in the district. The Fire Chief reports: "The majority of fires in the separate High Pressure Service District have been extinguished without the use of engines, although the number of engines responding to alarms remains the same as prior to the installation of the service."

The capacity of the Philadelphia system is nearly three times that of Providence. Philadelphia reports, "Number of fires during year 1904, 54. Of these 42 were controlled by chemical engine service, and only 12 were serious; these were extinguished by the High Pressure System alone without the use of

the Steam Fire Engine System." "The system is equivalent to twenty of the best fire engines, all of which are displaced at fires."

The capacity of the system proposed for the Central District of Chicago is more than three times that of Philadelphia, and under the present system could be delivered at one spot only by an army of men called in from widely separated points, yet this immense volume of water can be thrown upon one fire from the high pressure hydrants and stand pipes without invoking the aid of one unit of the former service.

None can foretell how much the force will decrease in the high pressure district as the handling become perfected, and large fires disappear, but it should never be larger than the present force with the fire boat and fire engines omitted retaining the hose sections only of the engine companies.

Table XVII shows the details of the existing expenditure in the Central District as compiled by Chief Campion and the expenditure in the same district after the High Pressure System is in operation on the basis stated.

TABLE XVIII.

Comparison of fire department cost in the Central District.

	As Now.	*As High Pressure.*	*Surplus.*
Grounds, buildings and furnishing.	$320,500	$160,250	$160,250
Apparatus and equipment.....	267,180	83,500	183,680
Maintenance and operation.....	354,848	177,424	177,424

It should be noted however that the capacity of the force as now is very deficient and can be increased only by robbing other territory.

The comparison ought at least to be drawn with a minimum standard of satisfactory operation of the present system. A tolerable arrangement, but satisfactory during the immediate future only, requires double the present status as a fixed force not subject to call from other districts, yet able to call upon these districts for help in case of extreme need.

The extinguishing power of the present force in the district, when on hand, is only 8,500 gallons per minute and near the river front 15,000 gallons per minute. When doubled and fixed the capacity would be 17,000 gallons per minute and near the river front 30,000 gallons per minute.

TABLE XIX.

	As Now, Capacity Doubled.	As High Pressure.	Surplus.
Ground, buildings and furnishings	641,000	160,250	580,750
Apparatus and equipment	537,360	83,500	443,860
Maintenance and operation	709,696	177,424	532,272

The installation of the high pressure system will thus avoid an investment in the fire department of.....$587,680
An additional annual cost of operation of..... 354,848
And will divert to the protection of other districts an existing investment of..... 343,930
And an operation expense of..... 177,424

Moreover the high pressure system is not only a limit to the expansion of expenses, growing out of fire but a reducing force of great power. On the other hand there is no limit to the ultimate expenditure under the present system. It expands with the expanding fire losses with which it fails to cope.

QUESTION IV. WHAT ANNUAL REVENUE CAN BE DERIVED FROM THE HIGH PRESSURE SYSTEM?

Revenue will accrue from the connection of apparatus of buildings with the system. The connection will save the property owner expense in tanks or pumps required to complete the protection of his premises. The rate for annual service must therefore represent a business proposition or the property owner will avoid the connection. When the property owner lays out money to protect his premises the city benefits because the building will demand less of the protection furnished by the city. The rate charged for the high pressure service should therefore be moderate.

The sources of revenue for the high pressure system are four classes of property.

1. Buildings over 100 feet high.
2. Buildings having deficient equipments of sprinklers.
3. Existing building deterred from installing sprinklers by undue cost of water supply.
4. New buildings equipped with sprinklers.

1. Buildings Over 100 Feet High.

The City Ordinance declares that all buildings over 100 feet high must have stand pipes under pressure.

There is no middle ground in fire protection. Adequate fire protection is a standing challenge to hazard, inadequate fire pro-

tection a standing bluff. *No law can make good to which sham safety looks good.* The sizes of the stand pipes should, therefore, be ample in view of the probable demand, and the delivery should be forthcoming promptly and at all times. Very few buildings can satisfy these requirements under ordinary conditions of operation. The cost of being ready to respond to the demand nights, Sundays and holidays the year round will in most cases dictate the adoption of a pump driven by an electric motor which starts automatically at any time upon opening a valve, and costs but little to operate.

The average capacity will be at least 1,000 gallons per minute, equal to four ordinary fire streams or one large fire stream. A large suction pipe will be needed to enable the pumps to draw water from the mains in the street.

The cost of the average pumps and connections complete will be with steam, $3,500, and with electricity, $7,500.

The number of existing buildings affected by the ordinance is 220, of which 20 may have sufficient suitable pumps, leaving 200 interested. The cost to these buildings will be between $700,000 and $1,500,000.

Moreover low buildings are constantly giving place to high buildings; ultimately the expenditure will be shared by 1,000 buildings, and amount to between $3,500,000 and $7,500,000, depending upon the choice of pumps. Every owner of property subject to this conclusion is interested in connecting with a system which would substitute a fair annual rate involving only a small fixed investment not liable to depreciation.

The existing floor area thus interested is 200 buildings with a total area of 26,000,000 square feet.

New office and business buildings should add in five years 6,000,000 square feet.

2. Existing Buildings Equipped with Automatic Sprinklers, but Deficient in Some Particular.

Nearly all building equipped more than five years ago fail to secure the full credit in rates because of some particular which differs from the standard now in force. The ability to offset small deficiencies by greater certainty of water supply should attract in this class not less than 10,000,000 square feet of floor area.

3. Existing Buildings Deterred from Installing Sprinklers by Undue Cost of Water Supply.

The proportion of existing large ordinary buildings equipped with sprinklers is now nearly fifty per cent. It is a fair de-

duction that fifty per cent of those outstanding would also become equipped if the difficulty of providing and supporting immense tanks were removed.

The number of ordinary buildings between the areas of 15,000 feet and 35,000 feet which have been equipped is surprising in view of the undue relation of the cost of water supply to the total cost of equipment in such buildings; it is practically prohibitory. Undoubtedly a considerable total area in these sizes would equip if the cost of the water supply were greatly reduced.

Under these assumptions the area interested would amount to, large buildings, 12,000,000 square feet.

Small buildings, 5,000,000 square feet.

In many old buildings the tendency to connect and equip would be strengthened by release from structural alterations which the increased protection would obviate.

4. New Buildings Equipped with Sprinklers.

With rare exceptions all modern buildings for business or manufacturing use are equipped with sprinklers. The growth of these buildings in the three sections of the Central District is large each year and the accessions from this source in five years should total not less than 5,000,000 square feet floor area.

The expenditure which can be avoided in the approaching new equipments through connection with the system amounts to $700,000.

TABLE XX.

Summary of possible business; near future only:

	Square Feet.
1. Buildings over 100 feet high	26,000,000
New office and business buildings in five years	6,000,000
2. Old sprinklered buildings	10,000,000
3. Large buildings now deterred from equipping by cost of water supply	12,000,000
Small buildings now deterred from equipping by cost of water supply	5,000,000
4. New buildings equipped with sprinklers	5,000,000
	64,000,000

At this stage in the process of improvement, 96,000,000 square feet of property would be endangered and subjectd to

undue expense by a remnant of old large buildings amounting to only 12,000,000 square feet; buildings also which cremate working women and drain the pension fund of the fire department. If the weight of opinion should favor enforcing a general standard of safety, this remainder would also equip, and the grand total of area connected with the high pressure system would be 76,000,000 square feet.

A moderate annual charge based on floor area would therefore suffice to meet the entire direct expense of operation and maintenance of the service.

QUESTION V. WILL THE FIRE INSURANCE RATES BE LESS?

Estimates of changes in rates must take account of precedents. The methods of doing business in Fire Insurance will continue as before. Two changes may be expected under this assumption, one affecting the insurable property in the Central District, and the other all insurable property in the city.

1. A general credit may be expected upon the insurable property in the Central District due to the superior protection. In Philadelphia (Page 80), the credit was large, but was in the nature of the removal of a penalty for deficient water supply which does not apply in Chicago.

In Providence (page 85), however, the situation in respect to mains, pressures and hydrants prior to the High Pressure Service was beyond criticism, nevertheless, each building within 200 feet of a high pressure main received a credit of 5 per cent off the rate as soon as the system was put in operation.

2. A general credit may be expected upon all insurable property in the city as soon as the Central District becomes standard in which case a large volume of fire losses would be permanently cut out in a manner susceptible of undeniable proof. The amount cut out would exceed 25 per cent of the total loss of the city, and a 25 per cent reduction in total premiums would therefore become due. The precedent for such action is to be found in Boston where a large reduction was made by the Fire Insurance Organization upon request of the business interests of Boston calling attention to the superior protection given by the city and the low rate of loss.

In addition there should be opportunity to profit by special combinations of alarm service with the High Pressure Service, particularly in the case of stand pipes in buildings over 100 feet high.

SUMMARY OF ANSWERS TO QUESTIONS.

The analysis has proved that the great loss in the Central District, practically $2,000,000.00 per annum is largely due to one class of buildings of dangerous character, but constituting a minor portion of the total floor area and value at risk. Furthermore, these buildings occasion all the heavy work of the fire department, and the need for more fire companies and continually call out companies in districts from which none should be withdrawn for a moment. Assuming that in the end this situation will be changed forcibly, if not voluntarily, the following results will be due.

TABLE XXI.

SUMMARY OF RESULTS—TOTAL NET ANNUAL COST OF OPERATION.

The Central District.	As now.		As with standard high pressure.
The City—			
Investment Fire Department ....$587,680 at 5%	$ 39,384	$243,750 at 5%	$ 12,187.50
Operation Fire Department.....	354,848		177,424.00
Additional Investment now needed .....$587,680 at 5%	39,384		
Additional Operation now needed	354,848		
Investment, High Pressure at 5%		82,500	
Alarm Service		10,000	
Operation, High Pressure		25,000	
		$117,500	
Less Revenue		35,000	
Net Operation, High Pressure....			82,500.00
Total.....$788,464			$272,111.50

The Property Owners—	As now.	As standard high pressure.
Stand pipes, $400,000, inside district, at 5%..	$ 20,000	$ 20,000
Pumps, $1,000,000, inside district, at 5%.....	50,000	
Theatres, $1,000,000, at 5%	50,000	50,000
Fireproofing, $4,000,000, at 5%	200,000	250,000
Sprinklers, $2,000,000, at 5%	100,000	200,000
Insurance, inside district	3,600,000	
Insurance, outside district	5,900,000	
Charges for high pressure service.....		35,000
Insurance inside district under high pressure 5% and 25% reduction.....		2,565,000
Insurance outside district, 25% reduction.....		4,425,000
	$9,920,000	$7,545,000

The city gains net per annum	$ 516,352.50
The property owners in the district	900,000.00
The property owners outside the district	1,475,000.00
Total	$2,891,352.50
Investment by city in high pressure less investment avoided by Fire Department	$ 1,000,000.00
Ultimate investment by property owners without high pressure in motors, pumps, tanks and piping in 2,500 buildings	10,000,000.00

CONCLUSION.

The High Pressure System for fire protection will save much, both in the cost of the protection given by the city and the protection which must be installed by property owners.

The High Pressure System combined with reasonable regulation of buildings will effect a marked reduction in fire losses, reacting upon fire insurance rates to such extent that the reduction in premiums shared by the whole city will amount each year to more than the entire cost of the system. The location of the high pressure system may be central, *but the streams of benefits reach every improved spot to the outermost boundaries of the city.*

These remarkable results lead to the query, should not the city inquire comprehensively what can be done in remodeling the existing water system to extend the benefits of this service, putting in separate pipes throughout valuable congested areas, but utilizing existing pipes where buildings are low, and 75 pound pressure under delivery will suffice.

The principle is sound, that the common interest demands a reasonable standard of private fire protection in large execptional buildings in order that the general safety may not be impaired or the cost of protection furnished by the city unduly increased. Cannot this principle be applied throughout the city so that the general situation shall be greatly improved?

Table XX shows the situation by years from 1872 to 1904, inclusive.

TABLE XXII.

Year.	Fire insurance premiums.	Fire insurance fire losses.	Fire department yearly expenses.
1872	$ 2,470,969	$ 351,182	$ 432,057.34
1873	2,691,454	611,683	586,618.96
1874	2,772,557	2,139,509	624,795.22
1875	2,566,994	258,834	411,245.12
1876	2,074,706	387,951	478,340.22
1877	1,712,165	1,044,997	507,001.12
1878	1,677,158	306,317	389,692.36
1879	1,868,347	510,014	420,308.82
1880	2,156,625	1,087,537	454,304.18
1881	2,491,437	794,799	568,760.87
1882	2,624,430	581,610	545,021.03
1883	2,915,767	1,559,662	556,551.80
1884	2,924,351	1,243,434	657,957.46
1885	3,243,689	2,716,199	717,639.92
1886	3,420,682	1,589,594	823,413.02
1887	3,602,679	1,957,790	826,047.74
1888	3,718,950	1,614,265	893,475.09
1889	3,826,747	2,159,087	961,201.54
1890	4,036,025	2,074,856	1,278,337.41
1891	4,251,975	3,292,046	1,378,249.10
1892	4,578,897	1,640,257	1,459,754.93
1893	4,428,392	3,679,697	1,542,378.17
1894	5,358,452	4,717,949	1,500,542.62
1895	5,416,578	3,877,296	1,542,596.62
1896	5,302,117	2,813,634	1,502,942.66
1897	6,321,405	3,708,076	1,532,780.92
1898	5,936,578	4,071,711	1,566,081.96
1899	6,526,369	5,740,058	1,641,346.67
1900	6,977,096	3,080,054	1,678,410.09
1901	7,359,110	4,614,870	1,636,984.21
1902	8,229,084	4,729,072	1,645,548.93
1903	8,442,234	4,768,685	1,699,162.37
1904	9,004,247	4,740,249	1,780,096.39
	$140,930,266	$78,462,974	$34,239,644.86

Total of premiums and fire department expenses combined..$175,169,910.86
With allowance for uninsured loss, fire alarm rentals, and adjustments paids by assured..... 180,000,000.00

12 yrs., 1881 to 1892	$41,635.629	$21,223,599	$10,666,409.91
12 yrs., 1893 to 1904	79,301,662	50,541,351	19,268,861.61

Total premiums and fire departments, 1881 to 1892, incl.....$52,302,039
Total premiums and fire departments, 1893 to 1904, incl..... 98,570,524

THE LEADING FEATURES OF THE SITUATION ARE THESE.

The total of premiums and Fire Department expenses during the thirty-three years since the great fire is exactly the total then destroyed.

The total loss paid by insurance companies exceeds the total then paid and almost equals that incurred.

The fire loss is the basis of the premiums and for years both have compounded at the rate of 6 per cent. per annum, thus

doubling every twelve years. The Fire Department has been stinted. With proper allowance for Fire Department the total of premiums and Fire Department cost for the present year would be $13,000,000. Twelve years hence the total for the year will be $26,000,000.

Fire exacts all that the paper rent roll shows.

The chief factor in the growth of loss is the increase in the number of large fires. The danger daily becomes more iminent that several of these will conjoin so that each must be fought with a deficient force immeasurably increasing the chance of disaster. How long can the doubling process continue without trebling the force of the Fire Department? One alternative remains: To produce contraction in an expanding body, withdraw the fire. Remove the 3-11 and 4-11 calls from business property throughout the city. The ordinary rate of growth of the Fire Department will then suffice for all purposes of the future including the infrequent large fires in non-hazardous property. Fifty per cent. of the present losses outside of the Central District will be effaced leaving but $2,000,000 of fire loss to support less than $4,000,000 of premiums. To-day the loss of $4,775,000 requires premiums of more than $9,000,000.

The present situation is due to thirty-three years' neglect of a growing danger. The occasion of fire may be accidental, but not the prevention. *Only thoughtful, watchful and incessant seeking for results can prevent dangerous fires.*. The ignoring of this precept brought to naught the action taken after the great fire by the men of 1871. They made the city anew with thoughtful provision for safety but failed to ask as years rolled on, if the things upon which they relied were actually and not seemingly doing what they expected.

What was apparently settled for all time is set forth concisely in the following extract from an address at the dedication of the Chamber of Commerce, Ootober 9th, 1872, delivered by the then Mayor, Joseph Medill.

"Many very useful ordinances have been passed by the Common Council. But of all the acts done, and measures adopted since the fire, the one I deem of most value and importance to the future of this city is the fire ordinance, which extends the fire limits over six times its former area; forbids absolutely the construction of wooden structures within these limits; provided for the gradual extension of them, and compels the erection of heavy substantial exterior walls of incombustible materials, which will interpose a solid barrier against the spread of future conflagrations, and not yield like cob-houses before a torch of flames.

Under the old fire laws and state of things, the city was sure to burn up; it was only a question of time. The laws of chance and combustion made it inevitable. We had built a city inviting destruction by fire. High, thin walls, surmounted with huge wooded cornices, joists, and beams projecting through fire walls, a narrow fire-limits surrounded miles deep by tinder-boxes, with thousand of incendiary structures interspersed among the brick buildings within the fire limits. Thus all the requisite conditions of a huge conflagration were carefully provided, and it only needed a "dry spell," a strong southwest wind, and a cow to kick over a kerosene lamp among the straw of a stable to quickly create a fire beyond the control of a department demoralized by faction and lack of discipline. We ignored the laws of combustion, violated the rules of prudence, forgot the precepts of precaution, and suffered the consequences. Our sin was in the disuse of the brains given us by the Creator to observe the natural laws that govern our relations to matter."

We know now that the fire limits to which the Mayor referred with pride have since proved an arena in which hazard has burst all bonds of control.. The "heavy substantial exterior walls" from which so much was hoped have been tossed to and fro as were the "high thin walls" blamed for the undoing of the city. Again and again a stout blow has knocked out the city building ordinance. No matter how braced it always proved the inadequate bluff and was never the adequate challenge.

"We have rebuilt a city inviting destruction by fire."

"Under the present fire laws and state of things, the city is sure to burn up. The laws of chance and combustion make it inevitable."

The duplication of the total destruction in the great fire by an expenditure on account of fire during the thirty-three succeeding years is not what the men of 1871 set out to do but is the result of failure to perfect methods through constant observation and experience. *In using "the brains given us by the Creator" to overcome hazard, do not overlook the business methods given us by man, for the prevention of serious fire is a serious business.*

The question up to the more fully informed man of 1905, is shall we try what ought to be or endure what otherwise will be and in but ten years strike for the third time the great balance in favor of fire.

TABLE XXII.

Year.	What ought to be premiums and fire department expenses.	What otherwise will be premiums and fire department expenses.
1906	6,500,000	13,000,000
1907	7,000,000	14,000,000
1908	7,500,000	15,000,000
1909	8,000,000	16,000,000
1910	8,500,000	17,000,000
1911	9,000,000	18,000,000
1912	9,500,000	19,000,000
1913	10,000,000	20,000,000
1914	10,500,000	21,000,000
1915	11,000,000	22,000,000
	87,500,000	175,000,000

With allowance for uninsured loss, fire alarm rentals, and adjustments paid by assured.....$180,000,000

It is right to compel theatres and high buildings to spend millions for safety as has been done.

It is right also to make the safety of these millions and the hundreds of millions which they protect real by compelling other classes to do their share.

But is it not right to compel the citizens to spend millions in doing what the city can better do with a tithe of the sum. To fail thus means failure to be the city; on the other hand, to succeed thus means the High Pressure System.

Respectfully submitted,

HERMAN B. SEELY.

LETTER FROM THE FIRE MARSHAL

Giving Expenditure on Account of Fire Department in Central District.

CHICAGO, Ill., May 4, 1905.

Mr. H. B. Seely, Secretary, Commission of High Pressure Water Systems, City of Chicago:

DEAR SIR:—In answer to your favor of March 27th, will say that in the district bounded by Twelfth Street, Chicago Avenue, Halsted Street and the Lake there are eighteen fire companies, which are equipped as follows: 17 engine companies, 4 trucks, 4 chemical companies, 1 fire boat, 1 water tower, 3 battalion chiefs, 16 captains, 18 lieutenants, 15 engineers, 13 assistant engineers, 4 stokers (fire boat), 2 pilots (fire boat), and 172 pipemen, truckmen and drivers.

The salary list is	$305,048.00
" Apparatus	199,300.00
" Horses	11,200.00
" Harness	1,680.00
" Hose	50,000.00
" Play pipes	5,000.00
" Horse feed	6,600.00
" Beds, bedding and furniture	10,000.00
" Fuel	8,000.00
" House heaters	18,000.00
" Repairs for apparatus	5,400.00
" Repairs for houses	9,000.00
" Horse shoeing	2,800.00
Valuation of buildings	150,500.00
Valuation of ground	160,000.00
Grand total	$942,528.00

Yours respectfully,

JOHN CAMPION,
Fire Marshal.

Legality of Using Water Fund for High Pressure Water Systems.

January 27, 1905.

Honore Palmer, Esq., Chairman Commission of High Pressure Water Systems of the City of Chicago:

DEAR SIR—I have the request of your Commission for an opinion on the legality of using the water fund to construct High Pressure Water Systems in the City of Chicago.

July 20, 1903, the City Council adopted an ordinance instituting High Pressure Water Systems for fire protection only. (See page 994 Council Proceedings 1903-4.)

Section 1 of the ordinance provided that the compact portions of the City devoted to trade and manufactures shall be divided into districts, termed High Pressure District.

Section 2 provided that in High Pressure District the water used for fire protection shall be delivered at high pressure by mains and pumps separate from those furnishing water for other purposes.

Section 3 established an advisory commission, which shall be known as the Commission on High Pressure Water Systems, and which shall act during two years, and take charge of the institution of the systems.

Section 4 provided that the Commission shall comprise six representatives of business organizations and interests, and seven Aldermen, who shall be appointed by the Mayor; also a hydraulic engineer, who shall be appointed by the Mayor, and said section also provided that the Fire Marshal and Commissioner of Public Works shall be *ex-officio* members of the Commission.

Section 5 provided that the members shall serve without salary, but that the hydraulic engineer shall be paid not more than five hundred dollars per month.

Section 6 provided that the Commission shall define the limits of the High Pressure Districts, and determine in what order construction shall proceed; that it shall make plans and specifications of the systems; make an examination of past fire losses to ascertain where mains are most needed; report to the City Council such modifications of the building ordinance as may be desirable in High Pressure Districts; consult with heads of departments and recommend to the City Council such provisions as may be necessary to secure proper operation of High Pressure Systems and maintenance of proper records by the city; notify property

owners and tenants in the proposed districts of the intent to install High Pressure Systems, and solicit signatures for contracts for High Pressure service.

Section 7 fixes the qualifications of the hydraulic engineer, and provides that he shall act under the direction of the Commission, etc.

Section 8 provides that the Commission shall first consider plans for the district bounded by 12th street, Halsted street, Chicago avenue, and the lake; that general plans shall be made for this entire territory, with the intent of installing systems by degrees, beginning where there is most need.

Section 9 provides that plans for other districts shall be considered upon petition of 50 property owners concerned, and an affirmative action by the City Council.

Section 10 is as follows:

"SECTION 10. *Construction of Systems*—It is hereby made the duty of the Water Department to construct High Pressure Water Systems for fire protection, and the former methods of furnishing water for fire protection are declared to be inadequate and shall be continued only in residence portions of the city and temporarily in other portions until building improvements shall become sufficiently developed to warrant installation of High Pressure Systems. The plans approved by the Commission on High Pressure Water Systems, during the two years in which the Commission shall hold office, shall be constructed by the Department of Public Works, under the supervision of the Hydraulic Engineer."

Section 11 is:

"SECTION 11. The Commission shall make provision for use of High Pressure Water by property owners for purposes of fire protection. The Commission shall guard the interests of the city in planning such connections and shall proceed so as to incur no liability on the part of the city by reason of such connections. The Commission shall submit for the consideration of the City Council regulations to be observed by the property owners in making connections, penalties to be imposed for improper use of High Pressure Water and charges appropriate for different classes of property to cover cost of connection and annual service. No service shall be furnished except upon compliance with regulations established by the City Council.

Section 12 provides for the charges for the service to the property owners.

Sections 13 and 14 provide for the expenses of the Commission.

It will be observed that the purpose and object to be attained by the institution of the High Pressure Water System is better fire protection in those districts of the city which, because of the character of the buildings and enterprises conducted therein, require the installation of such system for sufficient and adequate fire protection.

Section 1, Article 10, of the Cities and Villages Act of 1872 confers power upon the City Council to provide for a supply of water. Section 3 thereof gives the City Council power to make all needful rules and regulations concerning the use of water supplied by the water works of the city, and to do all acts and make such rules and regulations for the construction, completion, management or control of the water works, and for the levy and collection of water rates, as the City Council may deem necessary and expedient. It also gives power to levy a general tax for the construction and maintenance of such water works. (P. 304, Hurd's Revised Statutes, 1903.)

By this statute municipal corporations are authorized to provide for a supply of water for fire protection and for the use of their inhabitants, by the erection, construction and maintenance of water works.

In my opinion no possible exception can be taken to using a portion of the money in the Water Fund to construct such High Pressure Water Systems, as such systems are within the purposes for which the water-works system of the municipality was organized, and the power of the City Council creating and providing for the construction of such systems cannot, in my opinion, be questioned, as authority so to do is conferred by the General Cities and Villages Act.

It appears from an examination of the ordinance creating the Commission and conferring powers and duties upon it, that it contemplates that the owners of property protected by the maintenance of the High Pressure Systems shall pay the charges fixed by the City Council for the cost of connection of their premises with the mains in the streets, and for annual service, which charge for annual service "shall be based upon the value of the service to the individual in relieving him of expense to which he would otherwise he put in completing the fire protection of his property." The systems will be self-sustaining and the revenue derived will be paid into the Water Fund. Property will be better protected from damage and destruction by fire, and the usefulness of the Water Department greatly enlarged, thus resulting in advantage

to the property owner and contributor to the Water Fund and also to the value of the Water Department as a great asset of the municipality.

Very truly yours,

(Signed) WM. H. SEXTON,
Assistant Corporation Counsel.

Approved:

(Signed) EDGAR B. TOLMAN,
Corporation Counsel.

DETAILS

OF

PLANS AND COST

IN

ALL CITIES

PLATE D.

THE HIGH PRESSURE SYSTEM IN THE CITY OF CHICAGO AS RECOMMENDED BY THE ADVISORY BOARD OF EXPERTS OF 1902.

General Description—The recommendations of the Advisory Board of Experts were observed in preparing this plan, which contemplates a total capacity of 30,000 per minute at 200 lbs. maximum pressure. Each section contains one pumping station of 10,000 gallons per minute capacity so interconnected that the entire combined capacity may be delivered in any section at the maximum pressure adapted to the height of the buildings. The loss of pressure from pumps to hydrants under maximum delivery is 50 lbs. in each section. Each gridiron is surrounded by large circulating mains, which are inter-connected at several points. No delivery pipe in the gridirons is less than 12 inches diameter. The requirements permit 8-inch pipe to be used in the alternate streets of the West and North Sections, and the plan shows this size, but the gain in efficiency through making these pipes 12 inch was so great in comparison with the slightly increased cost that the larger size was provided throughout in estimating the cost of the system.

Estimate of Cost—In estimating the cost of the system all mains in the residence portions of the North Section and the extreme North and West boundary mains of the North and West Sections were omitted as not likely to be needed within a period necessitating present consideration.

A minimum and maximum estimate was made to cover all contingencies. The following method was adopted to establish a limit of expenditure due to obstructions in the streets of the congested district. An average price per foot was fixed for laying each size of pipe, which was based upon the cost of work done by the city in the past with ample allowance for all observable changes in conditions. There are fifty interesections of streets in the congested district, and the maximum cost of passing the obstructions at these intersections would obviously not exceed the total cost of constructing a tunnel below all obstructions at each intersection; the estimate of maximum cost also contemplates the contingency of constructing new tunnels under the river at each point shown on the plan, except where traction tunnels are intended to be used at Washington and La Salle street. The maximum estimate further contemplates the adoption of the most expensive type of machinery at the pumping stations.

Areas Protected—The areas protected approximate:

South Section	.8 square miles.
West Section	.8 square miles.
North Section	.4 square miles.
Total	2.0 square miles.

TABLE XXIV.

Minimum and maximum estimate of cost of High Pressure System.

Plate D—South Section. Minimum cost:

One 10,000 gallons per minute turbine pumping station	$ 65,000
6,500 feet 24-inch mains at $10.00	65,000
16,800 feet 18-inch mains at 8.00	134,400
1,200 feet 14-inch mains at 6.00	7,200
83,900 feet 12-inch mains at $5.00	419,500
477 hydrants at $120.00	57,240
456 valves	39,660
4 fire boat connections	2,000
Total	$790,000

Maximum cost:

Tunneling at 50 street intersections	$ 75,000
Extra for cross compound pumping engines	45,000
Total	$910,000

TABLE XXV.

Plate D—West Section. Minimum cost:

One 10,000 gallon per minute turbine pumping station	$ 65,000
8,500 feet 24-inch mains at $8.00	68,000
7,600 feet 18-inch mains at 6.00	68,000
600 feet 14-inch mains at 4.00	2,400
75,800 feet 12-inch mains at 3.50	113,700
480 hydrants at $75.00	32,750
333 valves	21,550
One-half tunnel under river	8,000
Total	$357,000

Maximum cost:

Add one tunnel under river	$ 16,000
Extra for cross compound pumping engines	45,000
Total	$418,000

TABLE XXVI.

Plate D—North Section. Minimum cost:

One 10,000 gallon per minute turbine pumping station..	$ 65,000
4,600 feet 24-inch mains at $8.00 per foot.....	36,800
1,200 feet 18-inch mains at 6.00 per foot.....	24,600
1,200 feet 16-inch mains at 4.50 per foot.....	5,400
600 feet 14-inch mains at 4.00 per foot.....	2,400
24,300 feet 12-inch mains at 3.50 per foot.....	85,050
250 hydrants at $75.00.....	18,750
143 valves	10,000
One-half tunnel under river.....	8,000
	$256,000

Maximum cost:

Add one tunnel under river.....	$ 16,000
Extra for cross compound engines.....	45,000
Total.....	$317,000

TABLE XXVII.

Summary of cost—West and North Pumping Stations.

	Tunnels.	Obstructions.	Piping System.	Pumping Stations.	Total.
Minimum cost.	1 16,000	.....	467,000	2 130,000	613,000
Maximum cost..	3 48,000	.....	467,000	2 220,000	735,000

TABLE XXVIII.

Summary of cost—South, West and North Sections:

	Tunnels.	Obstructions.	Piping System.	Pumping Stations.	Total.
Minimum cost.	1 16,000	.....	1,192,000	3 195,000	1,403,000
Maximum cost..	3 48,000	75,000	1,192,000	3 330,000	1,645,000

Pumping Stations and Pumps—The fixed expense of operating isolated high pressure stations in constant readiness to meet the maximum demand is so great that careful consideration was given to the feasibility of utilizing the existing pumping stations as sites for the high pressure pumps. It appeared upon examination that there was ample space for high pressure pumps at three existing stations which could be inter-connected with but slight increased outlay for mains as compared with detached sites at the river. This arrangement also facilitates the use of steam, which is commonly regarded as the best source of power for fire protection purposes.

The tendency at present is to use turbine pumps driven by steam or electricity, but in order to provide for all contingencies

in the preliminary estimate, approximate estimates of cost were obtained from manufacturers of turbine pumps driven by steam turbines, turbine pumps driven by electric motors and cross compound steam pumping engines of a relatively high grade.

The maximum pressure was taken at 200 lbs., with the consideration in view that the pressure could be instantly increased at any time by taking water from the delivery mains of the ordinary pumps which afford a minimum pressure of 40 lbs.

There is no obstacle to prevent the use of the high pressure pumps at two stations as reserve pumps for ordinary service; the occasion of their use in the high pressure service will be exceedingly rare and may never arise after the district becomes standard.

Maximum Pressure.—The maximum pressure is fixed by the height at which a considerable volume of water might be demanded in fighting a spreading fire among tall buildings; a fire in a single tall building cannot call for sufficient water at the top to make a perceptible difference in pressure between the pumps at the stations and the base of the stand pipe, provided the delivery pipes are proportioned as recommended by the Advisory Board of Experts. The question of maximum pressure depends, therefore, upon the height of buildings which will become general in the future. The West Section contains but one building over 126 feet and the North Section none, and there is no reason to believe that either of these sections will develop extremely high buildings. The South Section contains one building 282 feet high erected some years ago, one tower 300 feet high, and one 308 feet high. In recent years the limit of height has been fixed at 260 feet and of the many buildings erected under this restriction only four have approached the limit and none have asked permission to exceed.

Undoubtedly the percentage of office buildings which approximate the limit of height will increase in the future but consideration of use will tend to restrict business buildings to the practical limit, which does not at present exceed 217 feet. Of the high buildings erected to date but sixteen exceed a height of 200 feet and we may therefore conclude that while the 260 feet height will become sufficiently prevalent to warrant provision for fighting fires at that level and that buildings of that height might become grouped so as to present the possibility of a moderate size fire spreading at that level, no large spreading fire will be encountered above a level of 210 feet nor a conflagration above a level of 160 feet.

The possible total demand of several high level confined fires may be estimated at 6,000 gallons per minute; that of the moderate spreading fire at 12,000 gallons per minute; and that of the conflagration at 30,000 gallons per minute.

Assuming sufficient stand pipes of 6-inch diameter for heights from 150 feet to 210 feet and 8-inch diameter for heights from 210 to 260 feet, and mains and pumping stations as in Plate D, 200 pounds maximum pressure, will suffice to handle any fire involving the foregoing conditions of delivery.

Tables XXIX and XXX show the relative number of fireproof buildings at different heights.

TABLE XXIX.

FIRE PROOF OFFICE BUILDINGS, HOTELS, AND CLUB HOUSES OVER 100 FEET HIGH.

	100 to 149 feet.	150 to 199 feet.	200 to 260 feet.	Over 260 feet.
South Section	23	41	14	1
West Section	none	none	none	none
North Section ...	1	none	none	none

TABLE XXX.

FIRE PROOF MERCANTILE BUILDINGS OVER 100 FEET HIGH.

	100 to 149 feet	150 to 178 feet	200 to 217 feet
South Section ...	34	15	2
West Section	10 up to 126 feet	1 up to 173 feet	None
North Section	2 up to 117 feet	None	None

Tables XXXI, XXXII and XXXIII show the results obtainable at different levels with 200 pounds maximum pressure at the pumps.

TABLE XXXI, SYSTEM PLATE D.

Table of approximate pressures at base of stand pipes under varying deliveries assuming 200 pounds pressure at pumps and 50 pounds loss of pressure with delivery of 30,000 gallons per minute.

6,000 gallons per minute.....	197.5 pounds.
12,000 gallons per minute.....	191.5 pounds.
21,000 gallons per minute.....	175 pounds.
30,000 gallons per minute.....	150 pounds.

TABLE XXXII, SYSTEM PLATE D.

Pressures at outlets of 6-inch and 8-inch stand pipes at different levels assuming varying numbers of stand pipes each delivering 500 gallons per minute.

Levels of Outlets— Six-Inch Stand Pipes.		160 ft.	210 ft.	260 ft. Eight-Inch Pipes.
12	500 gallons each,	126 lbs.	102 lbs.	84 lbs.
24	500 gallons each,	120 lbs.	98 lbs.	78 lbs.
42	500 gallons each,	103 lbs.	82 lbs.	62 lbs.
60	500 gallons each,	78 lbs.	56 lbs.	37 lbs.

TABLE XXXIII, SYSTEM PLATE D.

Pressure at outlets of 6-inch and 8-inch stand pipes at different levels assuming varying number of stand pipes each delivering 1,000 gallons per minute.

Levels of Outlets— Six-Inch Stand Pipes.		160 ft.	210 ft.	260 ft. Eight-Inch Pipes.
6	1,000 gallons each,	120 lbs.	97 lbs.	82 lbs.
12	1,000 gallons each,	114 lbs.	91 lbs.	76 lbs.
21	1,000 gallons each,	98 lbs.	74 lbs.	60 lbs.
30	1,000 gallons each,	73 lbs.	49 lbs.	35 lbs.

OPERATION OF THE SYSTEM.

Very little can be said of the operation of the piping system which is not wholly estimated.

In Providence and Philadelphia the cost of attention to mains, valves and hydrants appears to be nominal and the work so occasional that it is performed by the regular force without special note. In Providence the leakage from joints after eight years' use is only 100 gallons per minute and at the same rate would not exceed 15 gallons per minute in Chicago, an insignificant item in operating the pumping stations. Men would be required to operate valves at fires, but these should be connected with the companies of the Fire Department.

TABLE XXXIV.

Cost of Operating the Gas Station at Philadelphia For the Year 1904.

Number of units, 9; capacity, 9,100 gallons per minute; fire alarms, 54; fires in service, 12.

Labor	$7,880
Miscellaneous	2,328
Gas for power	1,770

Table XXXV shows the probable cost of operating a 30,000 gallon per minute gas pumping station in Chicago.

The experts making a test of the Philadelphia station recommended some addition to the force of men. Recognizing this

addition and using the actual cost of operating at Philadelphia as a basis, the cost of operating at Chicago, one large station of 30,000 gallons per minute capacity with three shifts of men would total as follows:

TABLE XXXV.

COST OF OPERATING GAS STATION AT CHICAGO.

Number of units, 13; capacity, 30,000 gallons per minute; three shifts required.

1 Chief Engineer	$ 2,250
2 Assistant Engineers at $1,440	2,880
3 Electrical Engineers at $1,200	3,600
18 Oilers at $900	16,200
Miscellaneous	3,500
Gas for power	5,300
Maintaining pressure	200
	$33,840

The annual cost of operating three separate stations of 10,000 gallons per minute capacity each would be between $50,000 and $60,000.

Neither of these arrangements would pay in Chicago where three stations employed in the regular service adjoin the mains of the district. The most feasible plan is to select these stations as sites for high pressure pumps making one station the working station and maintaing the other two as a reserve. It may result that no increase in force will be needed to operate the high pressure pumps or that a small addition will be needed at the one working station. Under no contingency could the outlay for the entire system thus arranged, including both pumps and piping system, exceed $25,000 per annum.

PLAN PROPOSED FOR CHICAGO

By Geo. W. Jackson, Hydraulic Engineer to the Commission

LETTER.

CHICAGO, January 20, 1904.

Hon. Honore Palmer, Chairman the Commission on High Pressure Water Systems of the City of Chicago, and Members of the Commission:

GENTLEMEN—In submitting to you my report relative to the institution of a High Pressure Water System for the City of Chicago, as directed by your Honorable Body, Friday, December 4, 1903, I would be pleased if your body, before taking up the report as to cost, and discussing plans, would accept this letter as explanatory of the conditions found in arriving at the conclusion outlined by the system now recommended.

The position of Hydraulic Engineer was accepted by me, believing I would be able to recommend to your Honorable Body a system that would not only fill the needs of the present day, but would also meet the requirements of our city even though it might exceed its present growth by fifty per cent.

I have endeavored to take into consideration the question of providing a system which would be positive under all conditions, no matter what changes might become necessary in the reconstruction of the different corporation or city systems which now occupy our streets and alleys.

As planned, the proposed work will not interfere with the construction of a subway, or if such a subway is to be built, the system can be kept in operation with the exception of a possible discontinued service from the high pressure mains to the extent of one block, during the construction of subway, and at the same time obviate as far as possible any element of damage to property owners or individuals, as well as removing the danger of flooding a traction subway due to possible break.

Appreciating the importance of a high pressure system to Chicago, especially in the down town district, and having in mind the condition of our city finances, I have endeavored to make it possible for your body to start installation of the system with the money now available. Any part of the system in the down town district can be installed, and as the Fire Department has a suitable fireboat, known as the "Illinois" (which boat has a capacity of about 8,000 gallons per minute, an

adequate supply of water for one fire), the system could be supplied from the fireboat pending its final completion.

I have had in view the recommendation of a plan which would take care of the unsanitary condition of our present sewer system, feeling satisfied that the high pressure system should be connected with our sewer system for the purpose of flushing subsoil sewers, as well as for the washing of our streets; but after thoroughly canvassing the situation found it impracticable at this time, or at least unwise, to plan a new sewer system until such time as the subway question would be settled. The reason for this is, that knowing from absolute experience the condition of our streets and alleys (having constructed most of the underground systems for the different corporations operating under franchises granted them by the City Council), these, as well as our present sewer, fire-alarm, electric lighting, and domestic water pipe systems, occupy the street intersections to such an extent, that a new sewer system should not be built until something definite is arrived at relative to subway.

Accompanying this report is a cross-section of a subway plan which I designed and presented to a Committee of the Council some two years ago. The reason I submit this plan is to give you an idea of where the new sewer system should, in my judgment, be constructed. The plan also shows the relative position the high pressure water mains would occupy as recommended in the report.

At a meeting held Friday, December 4, 1903, there was some discussion by me as to the practicability of deriving a revenue from the sale of power by the city. After going over the subject thoroughly, in addition to securing valuable information from the Fire Department, I have come to the conclusion that it would be impracticable. The reason for this I find is, that the power as now generated by manufacturers and managers of the different buildings, can be produced as economically as it could be if generated by high pressure pumps. I have also found that, on account of the uncertainty of water consumption, if the high pressure mains were used for generating power, it might seriously interfere with the necessary flow and pressure required for fire purposes.

I have also come to the conclusion that the high pressure system should be constructed for fire purposes only, and that its operation should be under the absolute control of the Chief of the Fire Department. This, in my judgment, becomes

necessary in order that there may be no friction or misunderstanding of orders by subordinates at the power house, which might occur unless the control of the power house was vested in the Chief of the Fire Department.

Commencing with Section Eight of the Ordinance passed by the Council of July 20th, 1903, and running down to Section Thirteen, I find these sections apply to the interior of buildings, and refer to the installation of some proper mechanical appliance which might be adaptable for fire protection in buildings. After thoroughly considering Sections Eight to Thirteen relative to connecting the high pressure mains with automatic devices constructed for the purpose of conveying water to prevent the spreading of fire, I have come to the conclusion that there are three or four different sprinkler systems on the market which operate automatically, and in submitting my report and plans you will find provisions have been made whereby the high pressure mains can be connected with the automatic sprinkler systems; but these connections should be made by the Fire Department.

I have endeavored to make the report and recommendations as concise and brief as possible, knowing you are all busy men, past experience having taught me that the best way to obtain a desired result is to keep as far away from the inventive and technical as possible; and hope I have succeeded in recommending to your Honorable Body a system which is practical and at the same time within the bounds of possible construction from a monetary standpoint.

The above reasons, coupled with the fact that work can be started at once without the delay incident to long legislation, leads me to believe your Honorable Body will be able to find a way of obtaining enough money yearly to finally complete the installation of the entire system.

Respectfully yours,

GEORGE W. JACKSON,

Hydraulic Engineer.

REPORT.

CHICAGO, February 9, 1904.

To the Honorable Chairman and Members of the Commission on High Pressure Water Systems of the City of Chicago:

I have the honor to submit herewith my report, accompanied with the plates for the construction of a High Pressure Water System for the City of Chicago.

The system as shown on Plate 1 is designed for a capacity of 30,000 gallons per minute, equal to 43,000,000 gallons for 24 hours, with a pressure at the pumps of 300 lbs. per square inch, the trunk mains and lateral conductors being of sufficient size to give a hydrant pressure of 200 lbs. per square inch after being forced through a trunk main 36 in. in diameter, 9,000 ft. in length, with a velocity of 9 ft. per second, and 8-in. conductors a distance of 4,000 ft., which would be the maximum distance the water would be subject to friction in order to reach any point in what is known as the down town district. In order to get this efficiency a 6-ft .4-in. x 8-ft. 4-in. conduit is designed. This conduit to be constructed by the tunnel method, and to be placed at about the center of the Chicago River at an average depth of 70 ft. below datum, as shown on Plates Nos. 2 and 3.

From the 6-ft. 4-in. x 8-ft. 4-in. conduit lateral distributors 4 ft. in diameter are designed. This 4-ft. lateral distributor to be built to a point about 100 ft. inside of the dock line and on such streets as are shown on Plate 1.

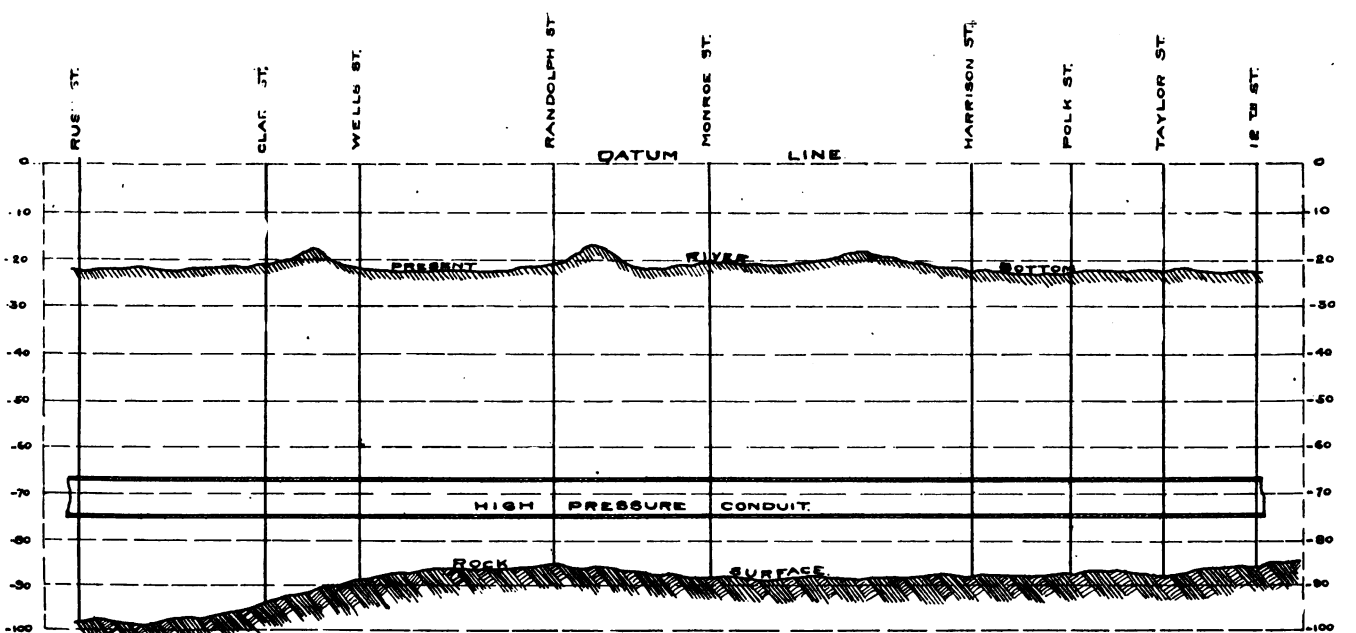
From the 4-ft. lateral running in a horizontal plane, a 4-ft. vertical shaft is designed. This 4-ft. vertical shaft is to be sunk from street grade to connect with the 4-ft. lateral.

In the 6-ft. 4-in. x 8-ft. 4-in. conduit there is designed to be placed a 36-in. steel pipe with proper flange connections. This 36-in. steel pipe to be manufactured to stand a hydrostatic pressure of 1,800 lbs. to the square inch. After the 36-in. steel main is placed in the conduit and at streets as shown on Plate 1, a 12-in. steel pipe is connected. The 12-in. steel pipe is then placed in the 4-ft. horizontal lateral and in the 4-ft. vertical shaft, to a point about 8 ft. from street grade. To the 12-in. lateral two 8-in. cast iron conductors are connected. The 8-in. conductors are to be manufactured to stand a hydrostatic pressure of 800 lbs. per square inch, and to be laid in streets as shown on Plate 1, with the necessary valves and fire hydrants. Plate 4 shows cross sections and thicknesses of the cast iron and steel pipe, as recommended.

LAND FOR PUMPING PLANT.

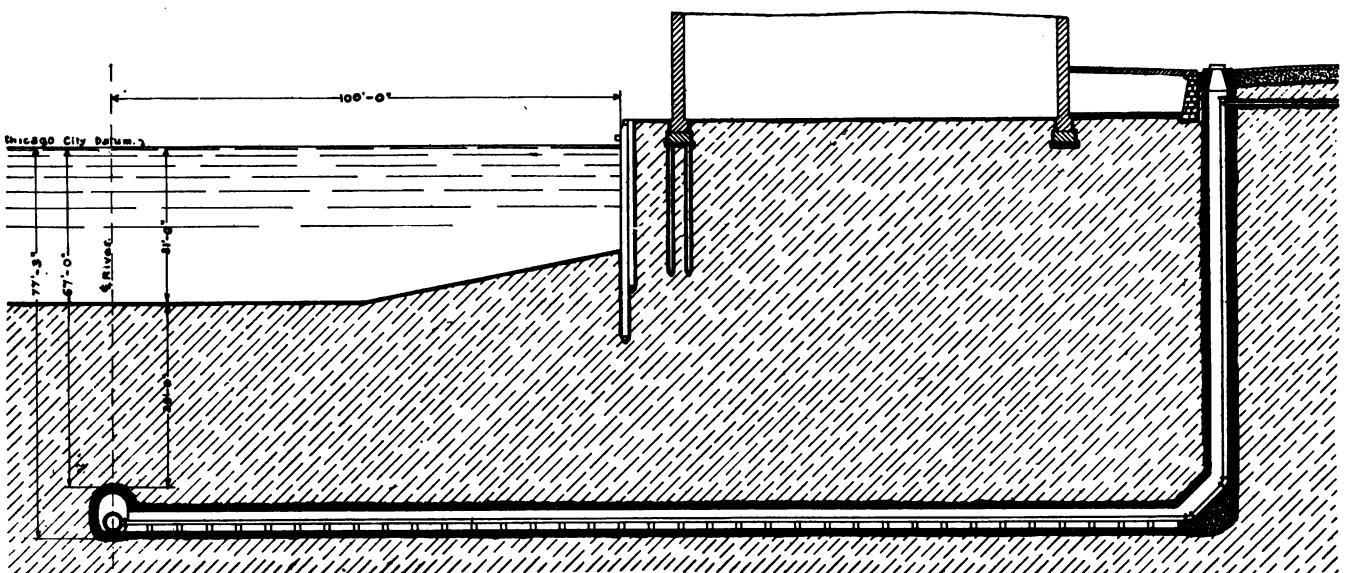
The location of the power house is left for the Commission to decide, it being practicable to locate it anywhere along the line of the present land tunnel, which land tunnel is shown on Plate 1.

The power plant would require about 24,000 square feet of land. The reason I do not specify any particular location for

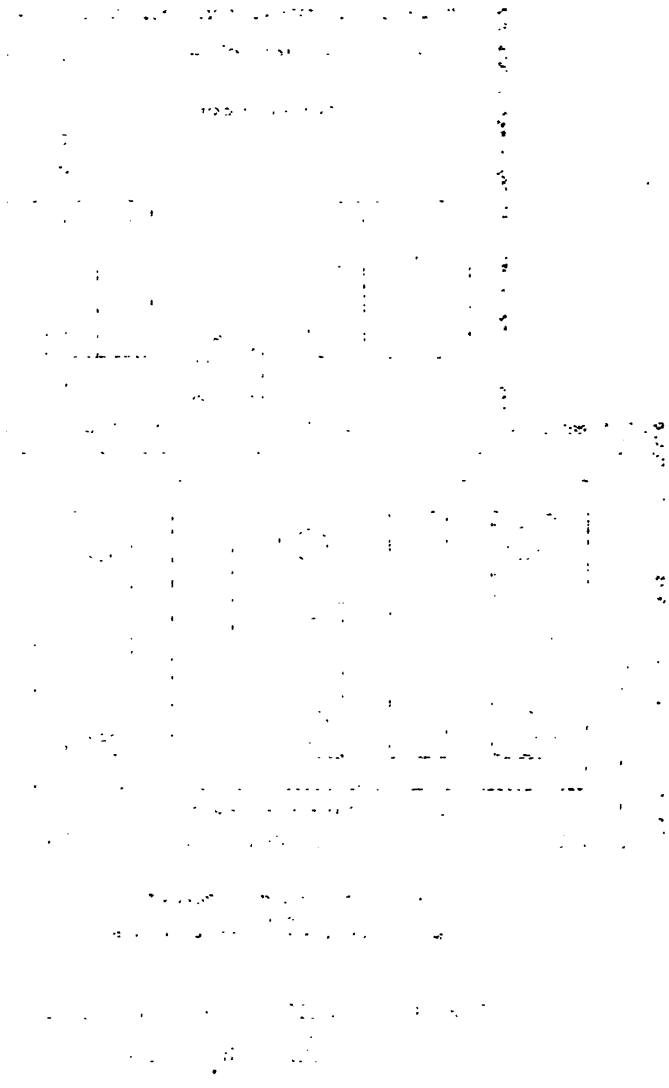


THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS OF THE CITY OF CHICAGO.

PLATE 2—Longitudinal Section of River, Showing River Bed, High Pressure Conduit and Rock Surface.



THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS OF THE CITY OF CHICAGO.
PLATE 3—Plan of Trunk Main, Conduit and Lateral.



the power house is that it does not increase the cost of the system if the power house is located on either side of the river, as the value of the property adjacent to the river either east or west, is about the same; I have also decided that it would be unbusiness-like to specify at this time any certain location, as it might increase the purchase price if it was generally known where the power plant was to be located.

PUMPING PLANT.

After gathering all data possible relative to the necessary machinery and mechanical appliances required to pump 43,000,000 galons of water per 24 hours, I have come to the conclusion that the most economical and practical power that should be used for pumping purposes is that which is generated by gas. The reason I have decided that gas engines would be the best, is from the fact that it will not become necessary to keep up pressure at all times, there being no question as to the absolute, positive operation of gas engines at this time, and as the cost of installing gas engines as compared with boilers and engines is about the same. As near as I can figure at this time the cost of maintenance per year of pumping plant would be about $8,000 less, if power is generated by gas engines as compared with the generation of power by steam. In figuring the relative cost of maintenance at power house, comparing power generated by gas with steam, I arrive at this conclusion in going over the amount of water which it has been necessary for the Fire Department to use during the past four years in putting out fires. Ground plans showing steam and gas driven plants are shown on Plate 6.

AVAILABLE WATER SUPPLY FOR SYSTEM.

In arriving at a conclusion as to the practical and economical way of obtaining the necessary water to supply the high pressure system, I have decided that it will be more practicable to use for surplus water from the present 7-ft. tunnel which furnishes the supply to what is known as the Harrison Street Pumping Station. This 7-ft. tunnel has a capacity of 72,000,000 gallons per 24 hours. The Harrison Street Pumping Station has a pumping capacity of 33,000,000 gallons per 24 hours, and as the high pressure system is designed for 43,000,000 gallons per 24 hours it would not impair the water supply at the Harrison Street Pumping Station. I do not believe it will become necessary for the Fire Department to use for over an hour a supply of water equal to 43,000,000 gallons per 24 hours; and in the

construction of a high pressure plant provision should be made to construct at some future day a tunnel for a supply independent of the domestic water supply.

There may be a discussion as to the necessity of taking water from a land tunnel on account of the water in the river being available. After canvassing the situation and obtaining data, I have come to the conclusion that it would be unwise to permanently design a power house with the idea of using the river water on account of the sediment it contains, experience having taught me that the uncertainty of the operation of valves and hydrants becomes a very important feature, especially so when valves and hydrants are subject to high pressures from water containing sediment.

INSTALLATION OF HIGH PRESSURE MAINS AND THEIR RELATION TO SUBWAYS.

In designing the system of high pressure mains, I have endeavored to keep in mind the fact that there has been considerable agitation and discussion relative to the construction of a traction subway.

The reason I have added these few lines relative to a subway is on account of the subway question becoming allied with the installation of a high pressure water system.

The water from the high pressure system should be used in washing the sidewalks, streets and alleys. This becomes impracticable to a large extent if a subway is built, on account of it being necessary, in my judgment, in order to properly wash our sidewalks, streets and alleys, to construct what is known as a storm water sewer system. In order to properly construct such a system it would require the mains to be laid on such a grade that it would become necessary to occupy certain spaces at street intersections, which spaces would have to be left open in order to properly operate a street car system in the subway.

The high pressure water system should also be connected to a new sewer system known as a subsoil system for the purpose of flushing. This subsoil system should be constructed of cast iron pipe in such a manner as to prevent the escape of gases. The construction of a subway would add largely to the cost of the new subsoil sewer system, as it would have to be placed in a position below the subway, making it necessary to maintain pumping stations at different points in order to free the system of sewage. This would not be necessary if a subway was not built, as the subsoil sewer system could be constructed below our street grade in such a manner that it would become what

is known as a gravity system, and the necessary pumping should be done by owners of property who could connect their sewerage system to the subsoil system.

The reason I conceived the idea of placing the high pressure trunk main in the center of the river, was due to my having in mind the impracticability of placing any large mains in the streets of the down town district, and even with the installation of 8-in. mains a large element of danger from damage would always be probable if it ever becomes necessary to have 8-in. high pressure mains installed in any subway which might be built for the transportation of people.

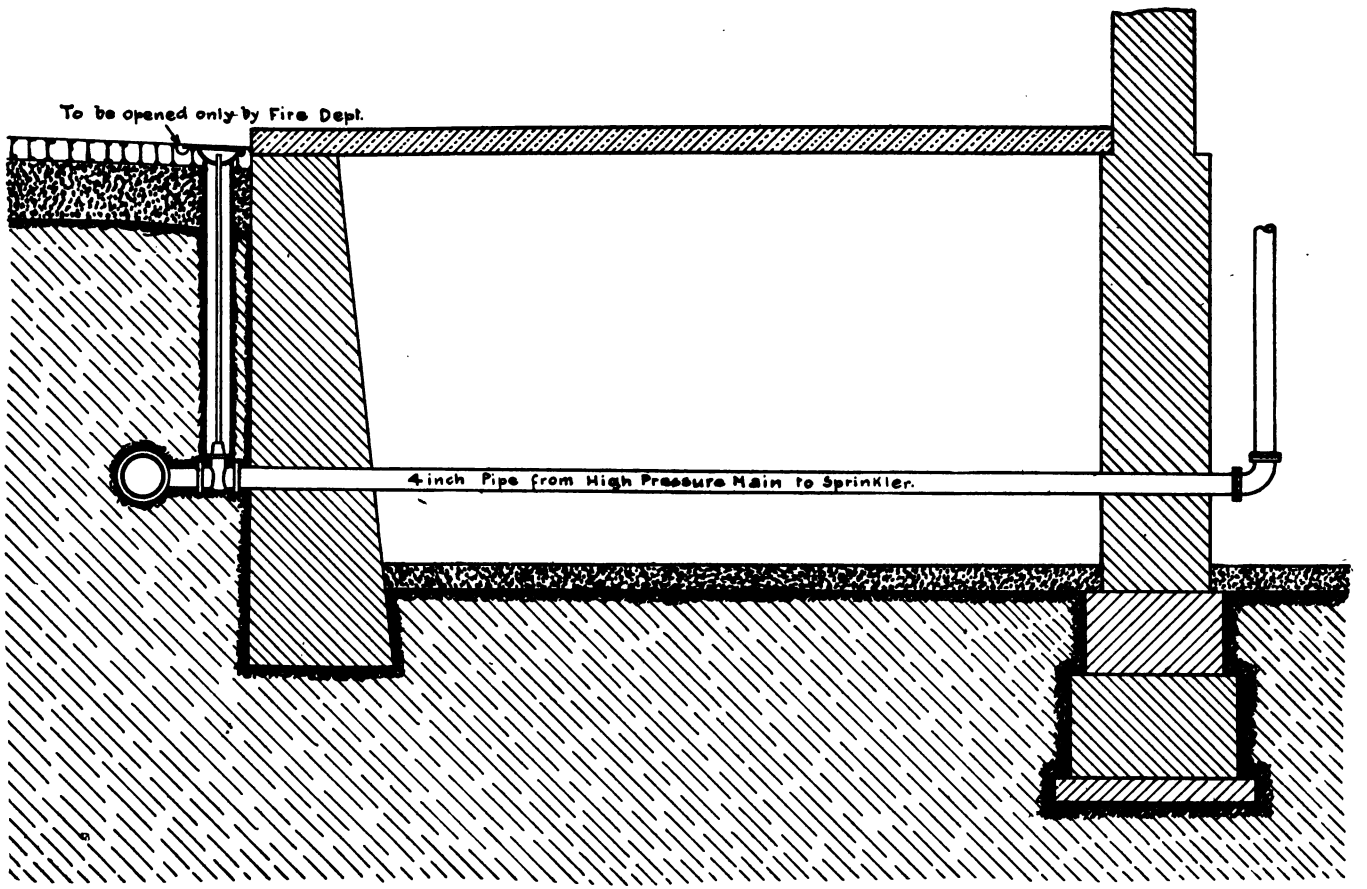
In closing this part of my report relative to subways and their connection with high pressure mains, I will add that there is nothing impractical or technical from an engineering standpoint in the way of constructing a subway, provided it is placed at a depth below street grade that its construction would not add unknown costs caused by atmospheric conditions deteriorating foundations of latter-day constructed buildings causing excessive strains on subway. Plate 5 shows the relative position of the 8-inch high pressure water mains and sewer systems in connection with a subway.

CONNECTING THE HIGH PRESSURE WATER MAINS TO AUTOMATIC SPRINKLER SYSTEMS.

As a preventive to the spreading of fire after its start, a sprinkler system becomes a valuable factor in assisting in stopping fire, and I have come to the conclusion that sprinkler systems should be installed in all buildings as a precaution and aid in extinguishing fire.

A system of tanks should be located in the basement of buildings or below the basement floor, these tanks to be of a size to hold a supply of water sufficient to supply the sprinkler system pending the arrival of the Fire Department. The tanks should be connected to a small air compressor, the compressor to be installed with an automatic starting device in such a practical manner that if the sprinkler system becomes operative, the automatic device would start the air compressor in order that the compressor would generate compressed air of sufficient pressure per square inch to force the water in the tanks through the sprinkler system to the required height necessary , or the tanks can be connected to a high pressure pump automatically started in buildings, but provisions should be made to prevent the sprinkler system from freezing.

The reason I recommend the installation of this system is, that it does not require the attention of an employe or engineer during the hours of the day, and especially so at night, when power is not kept up in the different buildings or manufacturing plants, when they are not operating actively, as the compressor can be connected to an electric motor and the current necessary to operate the starting device can be acquired from electric power generated and sold by corporations engaged in selling electric power. With a tank and compressor system installed in this manner, it obviates the necessity of reconstructing buildings or the erection of supports heavy enough to properly carry a tank of water on the roof of buildings of such size to hold a quantity of water necessary to have the assurance of sufficient flow. It also overcomes the objection from a financial standpoint, as the installation of a tank system with air compressor or high pressure pump can be installed in latter-day constructed buildings at a nominal cost, in addition to not occupying any room now occupied or which might be occupied in different buildings, as the tanks can be installed below floor level. The reason it becomes necessary in my judgment to use a system of this kind is, that I do not believe the city could afford to assume the responsibility of connecting the high pressure mains to the sprinkler systems without an intercepting valve, on account of the amount of damage that might occur from the uncertainty of pressure from the high pressure mains due to water rams, this uncertainty being such that it has been almost impossible for engineers to positively calculate the pressure that might come from the mains due to their becoming air bound. If air accumulates in the pipe systems and gets to a point between automatic air valves, it is at times the cause of serious water rams ,and the pressure caused by these water rams varies to such a degree that it becomes necessary to have the mains and different conductors tested to such a pressure that I am unable at this time to feel satisfied that any appliance designed to work on sprinkler systems, would give the degree of safety necessary to withstand this added pressure, and at the same time have the assurance that the sprinkler systems would act at the time they would be expected to operate; or if a serious fire should occur in a number of buildings, such as has recently occurred in Baltimore, if sprinkler systems installed in buildings were connected to the high pressure system direct, it would be the means of seriously crippling the high pressure system, caused by water discharging from the high pressure mains at a time when it would be



THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS OF THE CITY OF CHICAGO.
PLATE 11—Sketch Showing Sprinkler Connection to High Pressure Mains.

of no service in putting out fires, to say nothing of flooding the different premises; forms my opinion as to the impracticability of connecting sprinkler systems to the high pressure mains without an intercepting valve.

I do recommend connecting the sprinkler systems to the high pressure water mains in the manner as shown on Plate 11. As shown on this plate the sprinkler system is connected to the high pressure mains with a shut-off valve placed outside of the curb wall; this valve to be controlled by the fire department. With a system of tanks installed in the basement of buildings, these tanks connected to an automatically operated air compressor or pump and a connection made in the manner shown to high pressure mains, leads me to believe that every precaution possible to safeguard the city's interests has been taken. At the same time the system of fire protection is of such a character that property owners, manufacturers and business men would feel that they have protection for their property, from fire, and also give such assurance to insurance men to justify them in reducing rates, which would be beneficial to all interests where the high pressure system would be installed.

MATERIALS AS RECOMMENDED FOR THE HIGH PRESSURE

CONDUCTORS.

As shown on Plate 4 the conductors as recommended are of the sizes and thicknesses as indicated on plate, and are designed to be joined together with flange couplings.

Cast iron is recommended for the conductors where it becomes necessary to lay them in trenches. Steel pipe is designed to be used in the 6-ft. 4-in. by 8-ft. 4-in. conduit and the 4-ft. laterals and shafts.

Steel conductors after being placed in conduit and laterals will be at all times accessible, allowing them to be painted with a suitable mineral paint to prevent their deterioration.

VALVES AND HYDRANTS.

As shown on Plate 1, a system of valves and hydrants is designed, a sufficient number of shut-off valves being located to practically control the system in any block without shutting off any large territory, the hydrants being placed as shown at street intersections and in the center of blocks, allowing the fire department to have sufficient hose connections to hydrant, making it unnecessary to have lengths of hose exceeding 200 ft. in order to reach standpipes or dry sprinkler systems.

TELEPHONE SYSTEM.

A telephone system should be installed in connection with the high pressure mains, and the system should be built for the use of the Chief of the Fire Department and his assistants. An independent switch board should be installed at the power house of sufficient phone capacity, and the necessary wiring installed, in order that the Fire Marshal or his assistants would have telephone connection to power house on one of the corners of each street intersection. A portable tripod with telephone connection should accompany this system, these portable tripods and phones to be a part of the equipment of the Fire Department; and in the event of a fire the phones should be placed at street intersections connecting to the telphone wire system. With a telephone system installed in this manner the Chief of the Fire Department or his assistants would be able to be in connection with the engineer at power house which would enable the different fire marshals to regulate the pressure of water required for fire.

ESTIMATED COST OF SYSTEM AS SHOWN ON PLATE I, COVERING THE TERRITORY FROM 12TH ST. TO CHICAGO AVENUE, AND FROM HALSTED ST. TO MICHIGAN AVENUE.

11 Gas Engines & Pumps (2,800 gallons per minute each) 600 H. P. at $52,000 each	$ 572,000
Property, 24,000 square feet at $9.00	216,000
Power and Pump Building complete	110,000
Trunk Main Conduit, 11,300 ft. at $25.00 per lineal foot	282,500
Lateral Conduits 4-ft. in diameter, 6,900 ft. at $11.00 per lineal foot	75,900
36-in. Pipe, 8,600 ft. at $16.00 per lineal foot	137,600
24-in. Pipe, 2,800 ft. at $12.00 per lineal foot	33,600
12-in. Pipe, 61,200 ft. at $5.60 per lineal foot, including specials	342,720
8-in. Pipe, 237,200 ft. at $4.75 per lineal foot, including specials	1,126,700
850 Fire Hydrants at $120 each	102,000
36-in. Valves (4) at $800	3,200
24-in. Valves (3) at $500	1,500
12-in. Valves (72) at $130	9,360
8-in. Valves (880) at $ 80	70,400
Telephone System complete (200 phones)	120,000
Total	$3,203,480

NOTE—Total less telephones and mains in streets occupied by dwellings and stores, $2.883.000.

ESTIMATE OF COST FOR THE BUSINESS DISTRICT, WITH PRESSURE ACQUIRED FROM FIREBOATS.

12-in. Pipe, 5,000 ft. at $6.40 per lineal foot, including specials	$ 32,000
8-in. Pipe, 125,200 feet at $5.10 per lineal ft., including specials	638,520
335 Fire Hydrants at $120	40,200
12-in. Valves (10) at $130	1,300
8-in. Valves (574) at $ 80)	45,920
10 Fireboat connections complete at $900 installed	9,000
Necessary wiring and conduit for telephone system.	25,000
Total	$ 791,940

ESTIMATE INCLUDING FEEDER MAINS AND STATIONS.

This estimate includes pumps for 10,000 gallons per minute, with sufficient land for station to install pumps for 30,000 gallons per minute.

Building and pumps for 10,000 gallons per minute	$ 275,000
Land, 24,000 square feet at $9.00 per square foot	216,000
Trunk main conduit, 11,800 feet at $25.00 per foot	282,000
Lateral conduit, 4 feet diameter, 6,900 feet at $11 per ft.	75,900
36-inch pipe, 8,600 feet at $16.00 per foot	187,600
24-inch pipe, 2,800 feet at $12.00 per foot	33,600
12-inch pipe, 5,000 feet at $6.40 per foot	32,000
8-inch pipe, 125,200 feet at $5.10 per foot	638,520
335 fire hydrants at $120	40,200
584 valves	47,220
10 fireboat connections at $900	9,000
Telephone system complete	75,000
Total	$1,825,540
Deducting the telephone system, the total would be	1,750,540

RESULTS TO BE OBTAINED FROM SYSTEM.

With this system, the mains being constructed of the size and placed in the manner shown on Plate 1, with a power house designed and installed with a pumping capacity of 43,000,000 gallons per day of 24 hours, with an indicated cold water pressure of 300 pounds per square inch, at the discharge end of the pumps, a flow of water equal to 22,000 gallons per minute can be discharged from a system of sixteen hydrants, the style of hydrants being as follows: Four double and twelve triple discharge hydrants with 4-inch hose connections, these hydrants surrounding a territory, for comparison, from State street to Wabash avenue, and from Jackson boulevard to Van Buren street, would give a

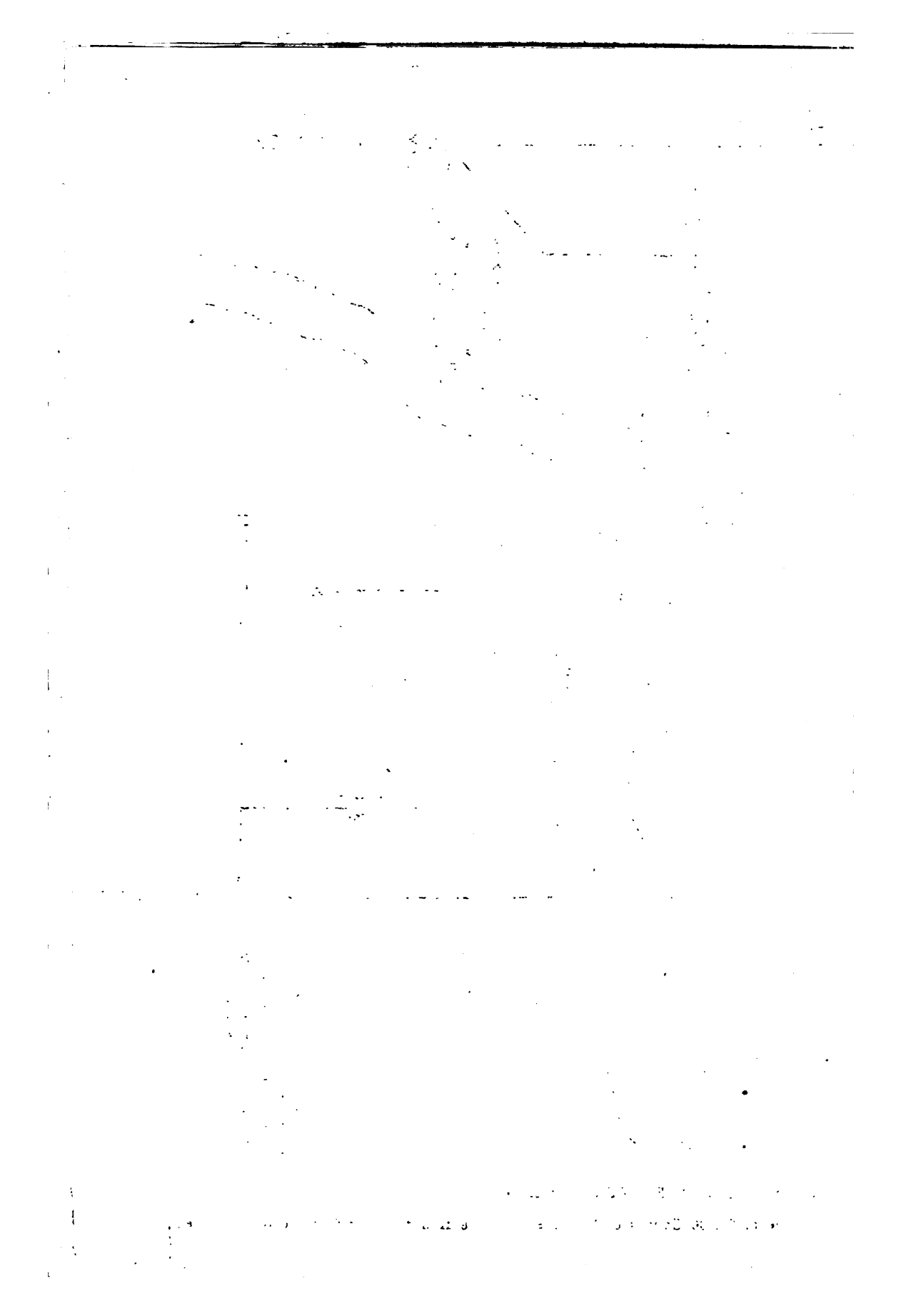
discharge of water from the 16 hydrants of 22,000 gallons per minute with a hydrant pressure of 200 pounds to the square inch. With this pressure and discharge of water the fire department would have available forty-four 1½-inch streams, and would be able to have a flow of water from each stream equal to 220 gallons per minute through a 1¼-inch nozzle after being conducted through 150 feet of 3-inch hose and 300 feet of 3-inch vertical standpipe, with a nozzle pressure at an elevation of 300 feet above street level of 25 pounds per square inch, which would throw water 40 feet horizontal and 35 feet vertical, or would give a height of water of 335 feet above street level, as shown on Plate 7. With 44 streams discharging 220 gallons each, there would be a discharge of 9,000 gallons per minute surrounding a block from State street to Wabash avenue, and from Jackson boulevard to Van Buren street, at an elevation above street grade of 335 feet, this being the longest distance that water would have to be forced through the mains and hose in the downtown district from the pumping station. With this supply of water as compared with the present equipment of fire engines the comparison as shown on Plate 8, would be as follows:

It would require 21 of the present fire department engines of the following classes: Six special extras, four extra firsts, and eleven first class; the best results obtainable from the twenty-one engines being a flow of 22,000 gallons per minute with a water pressure of 100 pounds per square inch at engines, a result equal to only one-half the flow and pressure that can be obtained from the high pressure system as outlined. This flow in one square block, however, it is impossible to obtain on account of the size of the city's present domestic water supply mains.

Plate 9 shows the available supply of water and pressures that can be obtained if five fires were to occur simultaneously in the high pressure district.

By the building of the 6-ft. 4-in. x 8-ft. 4-in. conduit, having it placed about the center of the river, as shown on Plate 3, it becomes an even distributor of water for all parts of the city, which is very important from an economical standpoint, on account of the cost of forcing water at high pressures through conductors.

Another important factor of the system as recommended, is that it entirely removes the element of damages probable from the breaking of high pressure trunk mains, as by the placing of the trunk main in the conduit, if a break should occur, the discharge would flow into the river, causing no damage whatever, and at



the same time making it possible to speedily and economically repair a possible break without entirely crippling the system.

The conduit can be extended up the South Branch of the Chicago river, as well as up the North Branch, and it allows the distributing of lateral conductors on either side of the river of small size, and at the same time giving an available supply of water to what is now considered the manufacturing or fire risk territory of Chicago, without adding the extreme cost of pumping, also removing the element of danger always probable from the installation of large size high pressure mains.

Another very important feature of the system as outlined is the fact that pumping stations can be located either on the North Branch or on the South Branch of the river, and can be connected to the system as outlined on Plate 1, making it a positive system for all parts of the city if such a thing should occur as there being a fire which would destroy one of the high pressure power houses. As an example: If the power house, which may be located anywhere in the vicinity of Harrison street, should become crippled by fire or acts of Providence, the power house which might be located in the vicinity of North avenue would be able to supply the high pressure system installed in the downtown district, giving that part of the system an available supply to the extent of the capacity of the pumps located at the northern power house, as the loss of pressure, if it became necessary to force the water from either a north or south power house through a 36-inch main, would not be such as to materially impair the flow of water for the downtown district.

The same result is obtained if the system is extended up the South Branch in the vicinity of Ashland avenue and the river, as the pumps which might be located in the power house at Ashland avenue and the river would be able to supply any part of the territory bounded by the North and South Branches of the river with a trunk main located as designed.

This becomes important, as it is my judgment that the high pressure system should as soon as practicable be connected to at least two pumping stations in order to insure a positive supply of water at all times for fire protection.

Another feature that is adaptable and practicable with the system as outlined is that it can be increased 100 per cent without any added cost for the construction of another conduit necessary for the placing of a 36-inch trunk main, as the conduit as designed is of sufficient size to accommodate two 36-inch trunk mains as shown on Plate 12.

In this connection I would like to add that the present city's domestic water supply can be materially increased by using the space allotted in the 6-ft. 4-in. x 8-ft. 4-in. conduit if it becomes desirable to do so, as a 36-inch steel conductor could be installed in the conduit and connected to the domestic water supply and used as such, pending the time necessary to use the said 36-inch main for fire purposes, as it may become necessary from time to time to extend the high pressure system.

With the system designed a saving to the city of many hundred thousand dollars is possible in extending the system, it being absolutely practicable to use 8-inch mains, the cost of 8-inch mains being about one-half of what it would be if it became necessary to adopt 12-inch mains. The 8-inch mains being fed from the 36-inch trunk main, located as designed, will allow a flow of water to be distributed sufficient to control fire or series of fires which might occur in any territory not exceeding two miles in length from the Chicago river.

Plate 10 shows the manner in which fireboats can be connected to the 8-inch mains if it is decided to start the installation of the high pressure mains in the downtown district.

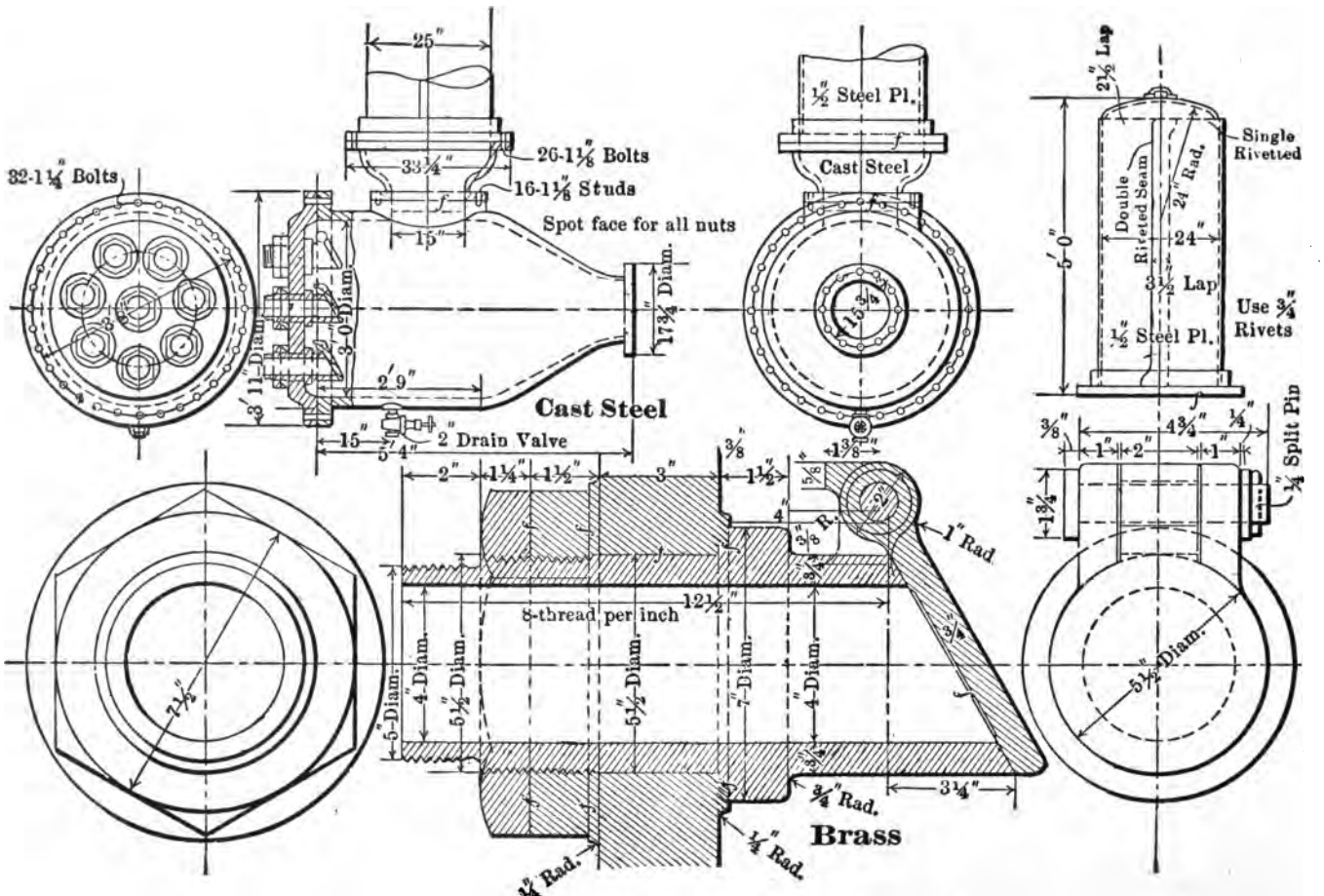
Plate 13 shows the system of 8-inch mains which can be installed pending the construction of the power house and trunk main.

Plate 14 shows skeleton plans of the existing high pressure mains as adopted in Buffalo, Cleveland, Detroit, Milwaukee, Providence and Philadelphia, and the Chicago system as outlined. In the cities as mentioned and as shown on plate comparing the systems as to area covered, the Chicago system covers about three times the area of any of the other cities.

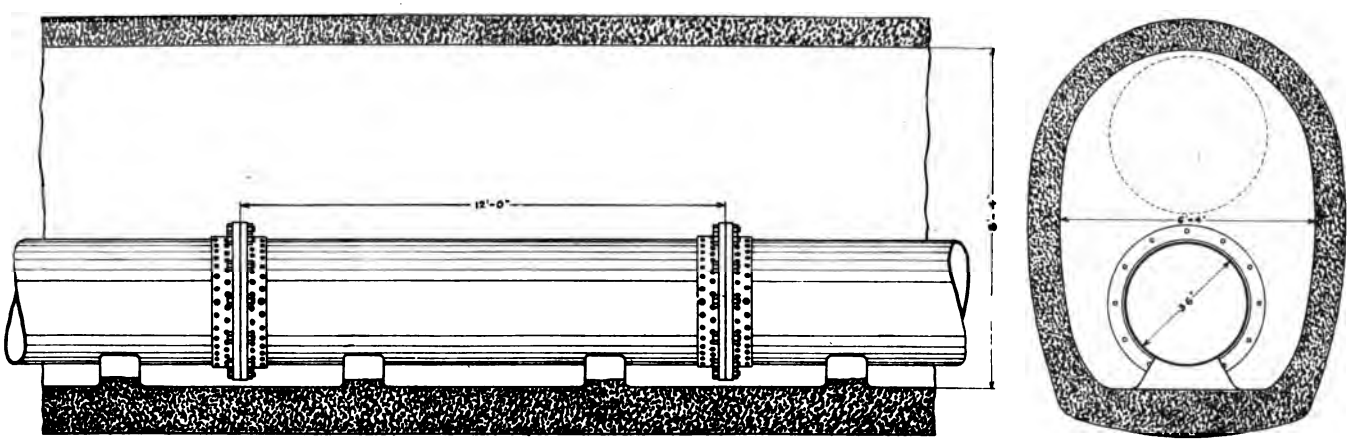
The only city which has as yet installed a power plant is Philadelphia, the power for this city being generated by gas engines, the rest of the cities obtaining their pressure from fireboats or reservoirs.

In preparing my report for your Honorable Body I have endeavored to make it as short and practical as possible, having spent considerable time in condensing the different subjects mentioned in the report, my judgment being that at this time it is unnecessary to furnish your body with any lengthy discussion of a technical character relative to strains, friction, etc., and I hope your Honorable Body will be able to understand the different subjects from the condensed reading matter and plates.

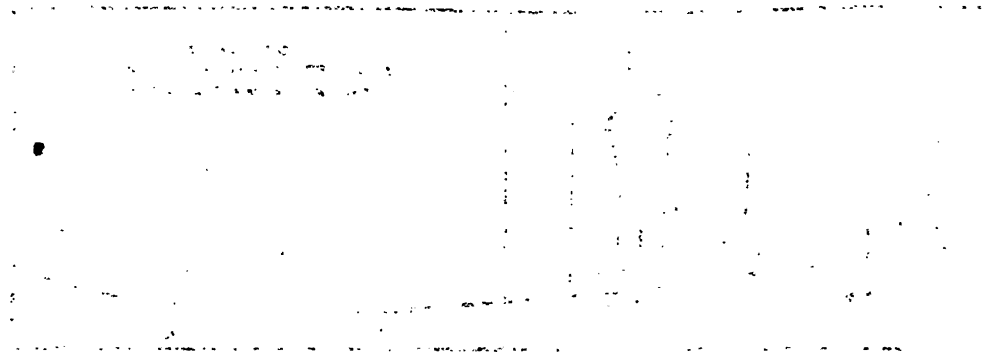
Chicago should establish no high pressure system that would prove inadequate to its present and future needs. I therefore call



THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS OF THE CITY OF CHICAGO.
PLATE 10—Detail of Fire Boat Connection.



THE COMMISSION ON HIGH PRESSURE WATER SYSTEMS OF THE CITY OF CHICAGO.
PLATE 12—Cross Section of Main Conduit.



attention to the methods described in this report, of establishing a sprinkler system in each individual building, with tanks in the basement and automatic devices for furnishing pressure as a temporary means of fighting fire.

In closing I desire to thank His Honor, the Mayor, Carter H. Harrison; Hon. Honore Palmer, chairman, and the members of the Commission for the courtesy and assistance extended to me in the preparation of my report; also Messrs. F. W. Blocki, Commissioner of Public Works; E. B. Ellicott, City Electrician; Wm. H. Musham, Fire Marshal; E. James Fucik, C. E.; John T. Fanning, C. E.; John Ericson, C. E.; John H. Spengler, C. E., and my corps of civil and mechanical engineers.

Respectfully submitted,

GEORGE W. JACKSON,
Hydraulic Engineer.

PLATE E.

THE HIGH PRESSURE SYSTEM IN THE CITY OF PROVIDENCE.

The City of Providence was the first in this country to install a separate system of mains for high pressure fire service. The installation was made in 1897. The system is supplied by gravity, but provision was made for subsequent attachment of a pumping station contemplating a maximum pressure of 166 lbs. per square inch. The capacity of the system is 3,472 gallons per minute. The maximum pressure under gravity ranges from 87 lbs. to 116 lbs., according to the level of the street, and the average size of pipes is larger than usual to permit of maximum delivery without falling below 100 lbs. in the important business localities. The district was well supplied with large mains and numerous hydrants prior to the installation of the high pressure service, but the experience of the district since the installation has confirmed the wisdom of the act. The piping was laid during the winter in paved streets and much of it with trenches stayed by sheet piling. The cost per foot under these circumstances, including hydrants, was $4.75. The area protected including a distance 400 feet on each side of the 24-inch pipes and a distance of 400 feet outside of the pipes laid in the outskirts of the system is about fifty-six one hundredths of a square mile.

DEPARTMENT OF PUBLIC WORKS

COMMISSIONER'S OFFICE
CITY HALL

PROVIDENCE, R. I., April 4, 1905.

H. B. Seely, Secretary, The Commission on High Pressure Water Systems, 218 LaSalle Street, Chicago, Ill.:

DEAR SIR—Your letters of the 18th and 31st ult., addressed to the Mayor, were referred to this department, but were not answered before, owing to the necessity of obtaining a portion of the information required from another department. I return herewith your schedule of questions filled out, and also mail you under separate cover a copy of the City Engineer's report, covering the installation of the separate fire service system, and trust that the information will arrive in time to be of service to you.

Yours truly,

HERBERT E. WOOD.
Secretary.

PIPING SYSTEM.

Depth laid, 6 feet 3 inches from curb to centre of pipe.

Number of feet, each size laid, 24-inch, 4,297.46 feet; 16-inch, 23,004.37 feet; 12-inch, 2,215.76 feet.

Cost of piping, $125,328.10.

Number and cost of valve, kind, 31, $2,461.90, Chapman.

Number and cost of hydrants, kind, 92, $11,960.00, Providence pattern, made by Coffin Valve Company.

Cost of keeping joints, valves and hydrants in order. Not estimated.

What amount of leakage has developed, 2,487 gallons per 24 hours.

How many connections made with buildings, 5 for automatic sprinklers.

Number of Fires—At all fires since 1897, in district where this service is installed.

Important Fires—Pressure at hydrants; 87 to 116 lbs. Pressure at nozzles, etc., unable to state. Lengths of hose, etc., unable to state.

Is the System Used as the Primary Means of Putting Out Fires—Yes. Engines when needed, are supplied from low service hydrants.

Are less Engines Used at Fires—The majority of fires in the Separate Service District have been extinguished without the use of engines, although the number of engines responding to alarms remains the same as prior to the installation of this service. No system of which we have knowledge will warrant the reduction of the number of fire engines.

Insurance Rates—A rebate of 5 per cent was made by the insurance companies, upon all risks within 200 feet of the pipe line when the service was first installed.

Fire Loss—Without this service the fire losses would unquestionably have been much greater.

Gain in Time—Six streams from any hydrant can be brought into service before one engine can be placed in line.

DEPARTMENT OF PUBLIC WORKS

COMMISSIONER'S OFFICE

CITY HALL

PROVIDENCE, R. I., April 15, 1905.

H. B. Seely, Secretary, The Commission on High Pressure Water Systems, 218 LaSalle Street, Chicago, Ill.:

GENTLEMEN—Replying to your letter of the 12th inst., the special fire service that is connected up to the sprinkler systems remains open at all times. The annual charge for such connection is $50. Yours truly,

WALTER F. SLADE,
Commissioner.
By H. E. W.

PLATE F.

THE HIGH PRESSURE SYSTEM IN THE CITY OF PHILADELPHIA.

The system shown in Plate 19 was completed in the year 1903; it was installed to remedy a deficiency in the existing supply of water for fire protection. An extra charge for fire insurance had been imposed on the property in this district which was removed after the installation had been completed.

The area covered by the pipes is about 2,500 feet wide by 6,500 feet long, and with allowance of 200 feet each side beyond the mains, equals 8-10 square miles.

The experience in operating the system throws much light upon the practicability of using extremely high pressures in fire service. The notable points in this system are the use of flanged and bolted joints in laying the pipes, the use of gas engines for power and the use of small distributing mains involving a large loss of pressure between the pumping station and hydrants under a maximum demand.

The funds for the construction of the system were derived from issue of bonds.

The main facts pertaining to the installation and operation of this system are given in replies made by the Philadelphia authorities to the questions asked by the Secretary. Quotation is also made of the letters written to Mr. I. M. DeVarona, Engineer of the High Pressure System in New York City.

DEPRATMENT OF PUBLIC WORKS
CITY OF PHILADELPHIA

PHILADELPHIA, March, 23, 1905.

Mr. H. B. Seely, Secretary Commission on High Pressure Water Systems, 218 La Salle Street, Chicago, Ill.:

DEAR SIR—Yours of the 18th inst., addressed to Hon. John Weaver, Mayor of Philadelphia, requesting information relative to the High Pressure Fire System in this city, was referred to this Department.

In reply thereto, please find below answers to your questions in the order requested:

Depth laid, average 6 feet.

Internal diameters of pipe system: Seven ¼-inch, ten 11-16-inch, fourteen ⅝-inch, and seventeen 13-16-inch.

NUMBER OF FEET LAID.

Seven ¼-inch, 10,795 feet.
Ten 11-16-inch, 15,514 feet.
Fourteen ⅜-inch, 5,562 feet.
Seventeen 13-16-inch, 1,510 feet.
No. 4 valves, seventeen 13-16-inch, cost $350 each.
No. 20 valves, fourteen ⅜-inch, cost $145 each.
No. 54 valves, ten 11-16-inch, cost $72.25 each.
No. 44 valves, seven ¼-inch, cost $42.50 each.
Valves made by Williamsport Valve Co. and Chapman Co.

HYDRANTS.

Post pattern, with two (2) 4-inch outlets, each controlled by separate valves. Cost $110; made at A. P. Smith Company's, Newark, N. J.

Cost of piping system complete	$445,000
Plus cost 166 hydrants	18,260
Making total	$463,260

Cost of maintaining valves, $5 per annum.
Cost of maintaining hydrants, $1 per annum.
Cost of maintaining joints, nothing.

Gravity pressure of 70 lbs. is kept constantly on the whole system. No leakage.

PUMPING STATION.

Size of building, 72 feet by 142 feet.
Cost of building, $82,000.
Number of 1,200 gallon pumps, seven.
Number of 300 H. P. gas engines, seven.
Number of 350 gallon pumps, two.
Number of 125 H. P. gas engines, two.

Cost of pumps, engines and connections complete	$178,000.00
Cost of operation in the year 1904	
Cost of labor	7,880.00
Cost of gas	1,770.00
Cost of supplies, etc	2,328.00

Number of fires during year 1904, 54. Of these 42 were controlled by chemical-engine service, and only 12 were serious. These were extinguished by the High Pressure System alone, without use of Steam Fire Engine System. At these 12 fires the pressure maintained at the station varied from 100 to 200 lbs. Maximum number of hydrants used, 2. Maximum height of building, 80 feet. Maximum length of hose laid, 500 feet. Size of hose, 3½-inch diameter.

Size of nozzle, 3-inch, 2½-inch.

The system is used at present on all second-alarm fires. The system is equivalent to twenty of the best steam fire engines, all of which are displaced at fires.

Fire losses, according to the Board of Fire Underwriters, have been reduced. Three hundred pounds pressure can be had at any fire hydrant on the system one minute after the alarm is struck.

In addition to the above we are sending you a copy of the annual report of the Bureau of Water for the year 1903, which gives a more detailed description of this system.

Yours respectfully,

PETER E. COSTELLO,
Director.

EXTRACT FROM THE REPORT REFERRED TO IN THE ABOVE.

"On December 10, 1903, a test of the capacity and power of the engines and pumps was made at the Race street wharf by Mr. J. C. Baxter, Jr., Chief of the Bureau of Fire. Four lines of 3½-inch rubber lines hose were attached to the fire boat connection at the river front, with one 2-inch diameter nozzle on each line of hose, and the streams directed into the river. Four pumps were put in operation, with a pressure of 150 pounds per square inch, which was gradually increased to 200 pounds, when it was seen that any further increase would be dangerous for the men holding the nozzle, as one of them had already slipped from its position and severely injured the fireman holding it.

The four streams were thrown to an estimated height of from 150 to 200 feet. The volume of water passing through the four nozzles was somewhat less than 5,600 gallons per minute, as the relief valves on the pumps were not entirely closed.

Note by the Secretary—A similar accident occurred during a test in April, 1904.

DEPARMENT OF PUBLIC WORKS

CITY OF PHILADELPHIA

PHILADELPHIA, April 17, 1904.

Mr. H. B. Seely, Secretary Commission on High Pressure Water Systems, 218 La Salle Street, Chicago, Ill.:

DEAR SIR—Yours of the 12th inst., requesting information relative to connections with the High Pressure Fire System, received.

In reply, would state that the fire hydrants in the street are the only connections made to the mains. They are under the exclusive control of the Bureau of Fire, which would not be possible with connections inside of buildings. A question of authority might occur at a critical time with connections on the outside of a building, and for this and other reasons no connections are made.

Yours respectfully,

PETER E. COSTELLO,
Director.

BUREAU OF PUBLIC WORKS

BUREAU OF WATER

ROOM 790, CITY HALL

F. L. HAND,
Chief of Bureau.

PHILADELPHIA, Pa., March 7, 1905.

Mr. I. M. De Varona, Chief Engineer, Brooklyn, N. Y.:

DEAR SIR—Replying to your favor of the 6th inst., relative to the efficiency of the High Pressure Fire Service recently installed in this city, I beg to advise you that this service, in its entirety, has given the highest degree of satisfaction and more than fulfills our highest expectations.

During the year 1904, forty-two (42) alarms of fire in the congested district were responded to, and in no case was there any failure in putting the pumps in operation or in the pipe service. In nine (9) of these cases the service was put into use, and rendered superior aid. In thirty-three (33) cases the service was put into action and was ready for use, but the Fire Department did not see fit to avail themselves of it.

The service always has been and is still able to operate, and our citizens generally acknowledge it to be the best piece of work installed in this city for years.

In evidence of this fact, I beg to refer you to the action of the Board of Underwriters who have reduced the insurance rates in the congested district 25 cents per one hundred dollars, and at the present time are asking the city for an extension of the service, stating that if $100,000 more shall be expended for extensions, they will further reduce the rates 10 cents on the $100.

This, I think, is the strongest kind of endorsement and fully demonstrates the confidence the Underwriters have in the system.

I am unable to give you the personal opinion of the Chief of the Department of Fire in regard to the system, but I enclose herewith a cutting from the Philadelphia Evening Telegraph of the 6th inst., giving an interview on the subject with Mr. David J. Smyth, Director of the Department of Public Safety, to whom the Chief of the Fire Department reports.

Trusting that the above statement will meet with your requirements, I am,

Yours respectfully,
(Signed) F. L. HAND,
Chief of Bureau.

DEPARTMENT OF PUBLIC SUPPLY

CITY OF PHILADELPHIA

CITY HALL

DAVID J. SMYTH, *Director.*

PHILADELPHIA, March 10, 1905.

J. M. De Varona, Chief Engineer,
Room 25, Municipal Building, Brooklyn, N. Y.:

DEAR SIR—In response to your communication of the 8th inst., permit me to say that all reports that have been made to me, regarding the workings of the High Pressure Service, have been to the effect that it was efficient in every particular. John W. Weaver, Superintendent of the Pumping Station, has made an exhaustive report of the various tests, which will be embodied in the annual report of this Department to the Mayor, and which will be in print early in April.

Briefly answering your letter the Superintendent has forwarded me the following data:

"The High Pressure Fire Service has fulfilled every condition imposed upon it, and its absolute efficiency has been proved every time it has been put in service. The mechanical plant and pipe lines have to date responded to 62 alarms of fire. On 10 of these alarms the system rendered perfect service; the other 52 alarms were slight fires, and were conquered by the use of chemical engines, although the power station was in use and the pipe service under pressure, ready for immediate use in all of the above mentioned alarms.

"In addition to answering alarms the entire system has been in operation, many time on exhibition tests, hose tests and operation drills for the firemen, and in no case has the plant proved other than highly efficient.

"There have been no attacks on the system. On the contrary, the strongest advocates in its behalf and its extension are the Board of Fire Underwriters."

The Superintendent also furnishes me with the following report, regarding a fire extinguished by the service yesterday:

"The High Pressure Fire Service was in use for thirty minutes yesterday on box 176, Sixth and Market streets. The exact location of the fire was Nos. 3 and 5 South Marshal street, Garret, Buchanan & Co., paper warehouse. The plant was operated 25 minutes; 10 minutes under 200 pounds pressure and 15 minutes under 100 pounds pressure for saturation purposes, when the fire was reported out. Of course the plant could create 300 pounds pressure, but it was not necessary to use higher pressure than 200 pounds. Along every line the entire operation was thoroughly successful." Very truly yours,

(Signed) DAVID J. SMYTH,
Director.

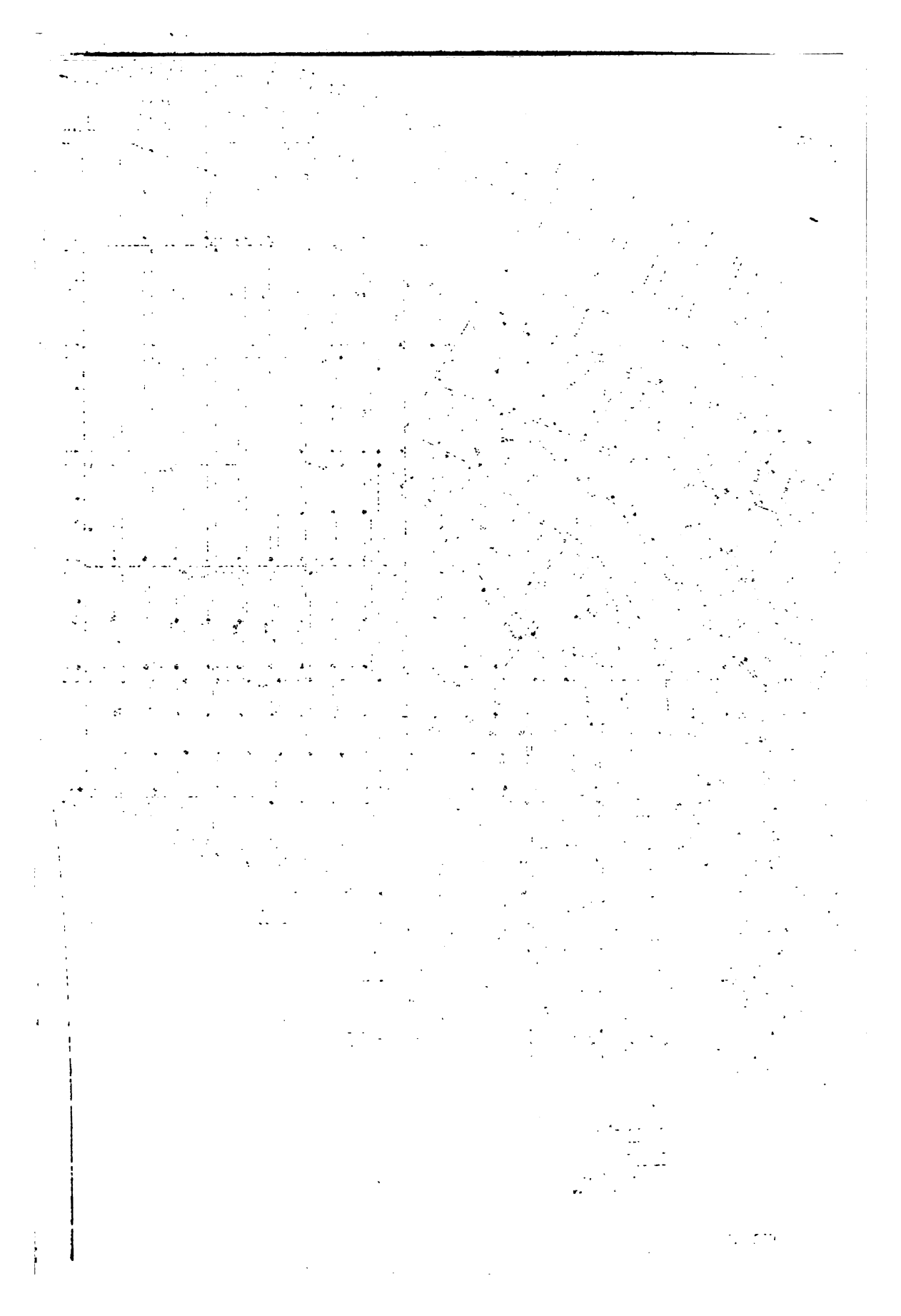


PLATE G.

THE HIGH PRESSURE SYSTEM IN THE CITY OF NEW YORK.

Plate 20 shows the plan adopted for the Borough of Manhattan, which was made by I. M. De Varona, Engineer.

The capacity is 30,000 gallons per minute at 300 pounds, maximum pressure. Two pumping stations are contemplated each of 15,000 gallons per minute capacity delivered to the gridirons through two connecting mains and supplied by turbine pumps driven by electric motors.

The gridirons are proportioned so that the fall in pressure from the pumps to the least favorably situated hydrants shall not exceed 50 pounds under maximum delivery. Large circulating mains are used and no pipe in the gridiron is less than 12 inches in diameter. Calked joints are to be used in laying the pipes.

The principles observed in this plan conform to those recommended to Chicago by the Advisory Board of Experts of 1902, except that a greater maximum pressure is contemplated.

The area protected is approximately 5,200 feet wide by 11,200 feet long and, allowing for ground outside the pipe lines, is about two square miles.

The estimated cost complete, including ground and stations, is $3,950,400.

The foregoing facts were taken from the report of I. M. De Varona, Engineer, to the Hon. John T. Oakley.

The system adopted in the Borough of Brooklyn embodies the main features of the system proposed for the Borough of Manhattan, but after a less comprehensive plan.

The proposals received for the Brooklyn work are of interest as showing the present cost of executing work of this nature in paved streets.

Schedule of Work, Borough of Brooklyn.

11,700 tons of straight cast iron pipe.
875 tons special castings.
115,000 lbs. of steel castings.
27,300 lineal feet 20-inch delivery pipe to lay.
34,500 lineal feet 16-inch delivery pipe to lay.
54,500 lineal feet 12-inch delivery pipe to lay.
7,400 lineal feet 8-inch delivery pipe to lay.
100 lineal feet 20-inch suction pipe to lay.
100 lineal feet 16-inch suction pipe to lay.
11,500 cubic yards of extra excavation.
76 20-inch stop cocks to furnish, lay, etc.
119 16-inch stop cocks to furnish, lay, etc.
142 12-inch stop cocks to furnish, lay, etc.
720 8-inch stop cocks to furnish, lay, etc.

87,500 lbs. cast iron gate boxes, etc.
8,200 square yards cobble pavements to relay.
725 hydrants to haul and set.
16,500 square yards block pavements to relay.
11,000 sq. yds. block pavements on concrete foundations to relay.
11,600 sq. yds. asphalt pavement on concrete foundations to lay.
220 sq. yds. brick pavements on concrete foundations to lay.
570 sq. yds. wooden pavements on concrete foundations to lay.
1,550 lineal feet bluestone curb to relay.
7,800 sq. feet bluestone flagging to relay.
6,960 sq. feet cement sidewalk to lay.
300 cubic yards concrete.
900 cubic yards brick work.
30,000 feet B. M. of lumber.
15,000 lbs. steel shapes.
460 cubic yards of rock excavation.
60 half-inch corporation cocks.

Two lowest proposals for the above: $792,601.50, $795,313.56.

With addition for hydrants, the proposal for the complete piping system would total $872,000.

The extent of the piping in the above tabulation is about 15 per cent greater than that required for the South Section of the Central High Pressure District, Chicago.

The funds for the construction of the New York system are derived from issue of bonds.

The following reply was made by the New York authorities in response to the request of the Secretary:

CITY OF NEW YORK
OFFICE OF CHIEF ENGINEER
13-21 Park Row.

NEW YORK, March 22, 1905.

H. B. Seely, Esq., Secretary Commission on High Pressure Water Systems, 218 La Salle Street, Chicago, Ill.: Chicago, Ill.:

DEAR SIR—Your letter of the 18th inst., addressed to His Honor the Mayor, has been referred to me.

In compliance with your request, I send you, under separate cover, report that I have just prepared and submitted on high pressure fire service for New York.

Yours very truly,

I. M. DE VARONA,
Acting Chief Engineer.

THE HIGH PRESSURE SYSTEMS

IN THE

CITIES OF TORONTO, WINNIPEG, CLEVELAND AND BALTIMORE.

The following responses were made by the authorities of these cities showing the status of each with reference to the High Pressure System:

CITY ENGINEER'S OFFICE.

TORONTO, March 30, 1905.

Mr. H. B. Seely,
Secretary Commission on High Pressure Water Systems,
830, 218 *La Salle Street, Chicago*:

DEAR SIR—Your letter of the 28th instant, addressed to His Worship the Mayor, has been forwarded to me.

We are now engaged in preparing plans and specifications for the installation of an auxiliary fire system. We propose to install four five-million-gallon turbine pumps, to give a pressure of 300 pounds at the pumps. Two of these pumps are to be operated by electricity and the other two by steam turbines. We are installing the plant at one of our Water Works Pumping Stations, so that we will be in a position to utilize the present staff, which will result in considerable economy in operation. The area we propose to protect is about 350 acres, and we intend putting in between seven and eight miles of mains, the largest main to be twenty inches in diameter and the smallest eight inches.

If there is any further information I can give you in this matter, please advise me.

Yours truly,

C. H. RUST,
City Engineer.

April 3d, 1905.

Mr. H. B. Seely, Secretary Commission
on High Pressure Water Systems, Chicago, Ill.:

DEAR SIR—In reply to yours of the 31st ultimo, $700,000 was the amount of money voted for the installation of an auxiliary fire system, of which $198,000 was for fire appliances, the remainder being for the pumping station and mains.

Yours truly,

C. H. RUST,
City Engineer.

WINNIPEG, CANADA

MAYOR'S OFFICE

WINNIPEG, CAN., April 14th, 1905.

H. B. Seely, Esq., Secretary, The Commission on High Pressure Water Systems of Chicago, Ill.:

DEAR SIR—I am in receipt of your letters, which owing to my absence from the city were not replied to sooner. However, it would have been impossible for me to have given you the information any earlier as the adoption of the installation has only just been passed by the Council.

The system we propose to install covers the wholesale or industrial portion of the City, and there will be about four miles of mains. We propose to pump the water from the Red River and install engines that will give a pressure of about 300 pounds at the pumps.

The properties within the benefited area are to be charged with the total cost of the installation. The rate is to be charged on the assessed value of the properties (land and buildings) and spread over a period of thirty years. The estimated cost of the installation is $380,000.00, and the sum to be levied each year for a period of thirty years to pay interest at 4 per cent per annum and to provide for a sinking fund to pay the debt at the end of the thirty years being $22,534.00. The estimated levy per $1,000.00 of assessment on the basis of the year 1904 being $1.47.

It is proposed that the City at large pay the cost of the operation of the system.

The property owners within the protected area may within one month from the date of the advertisement of the Council's intention to install such High Pressure System petition the Council against the same and the assessment of the cost therefor, but such petition in order to be sufficient to block the improvement must represent at least 60 per cent in value of the property affected. I may say, however, that the property owners are almost unanimously in favor of the improvement.

This system will be entirely distinct from the general Waterworks system, and there will be no connection with the High Pressure System mains except with hydrants and sprinkling system for large buildings.

The intention is to extend the system in future as may be required.

I enclose herewith a blue print showing the location of the mains as proposed, and the limits of the area to be assessed for the cost of the installation.

Trusting this is the desired information, I remain,

Yours respectfully,

THOS. SHARPE, *Mayor.*

CITY OF CLEVELAND

DEPARTMENT OF PUBLIC SERVICE

DIVISION OF WATER

CLEVELAND, O., March 31st, 1905.

Mr. H. B. Seely, Secretary Commission on High Pressure Water Systems, Chicago, Ill.:

DEAR SIR—In reply to your letter to the Mayor of March 28th, I would say, that the Committee of the City Council is still considering the development of our high pressure water service for fire protection. Just how much will be recommended is not yet certain. I think, however, enough will be granted; probably between $100,000 and $200,000, so as to permit a pretty good installation of mains in the business district between Erie Street and the Cuyahoga River with the power furnished for the present, as in the existing fire lines, by the fire boats, but with a special power plant a year or two hence located near the heart of the city on the Lake front or the River.

Yours very truly,

E. W. BEMIS, *Supt. Water Works.*

CITY OF BALTIMORE

WATER DEPARTMENT

BALTIMORE, April 1st, 1905.

Mr. H. B. Seely, Secretary Commission on High Pressure Water Systems, 218 La Salle Street, Chicago, Ill.:

DEAR SIR—Yours of the 28th ultimo, asking what has been done in this city towards towards the installation of a high pressure fire system, has been received.

Not long ago after the recent fire in Baltimore an ordinance providing for a high pressure fire service was introduced into the City Council, but no definite action has been taken on the ordinance by the Council, and it has been allowed to slumber. Outside organizations, however, and the General Improvement Committee, appointed by the Mayor to consider a general scheme of public improvements, have taken the subject up, and probably some definite action will soon be decided upon.

An estimate of the cost of such a service was made up in this office for a high pressure fire service to cover the burned district and a part of the surrounding business section of the city, a total area of about 227 acres. We estimated that to cover this area would take about 3½ miles of 20-inch main, 8.1 miles of 10-inch main and 600 feet of 30-inch suction pipe. The estimated cost was $397,998.60 exclusive of pumping plant. This cost would include standpipes or hydrants spaced from 50 to 60 feet apart throughout the entire system and four valves at each four-way branch. Yours truly,

ALFRED M. QUICK, *Water Engineer.*

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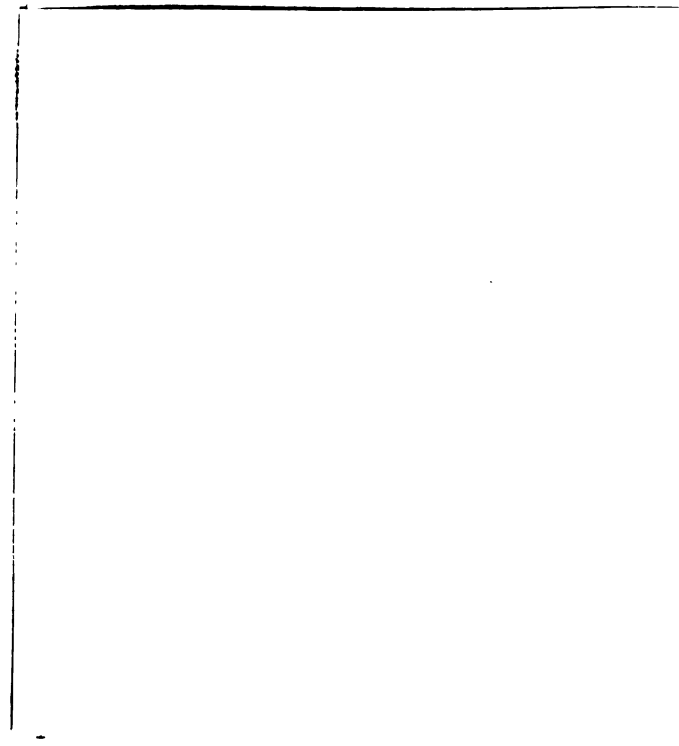
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